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AMERICAN EDUCATION SERIES

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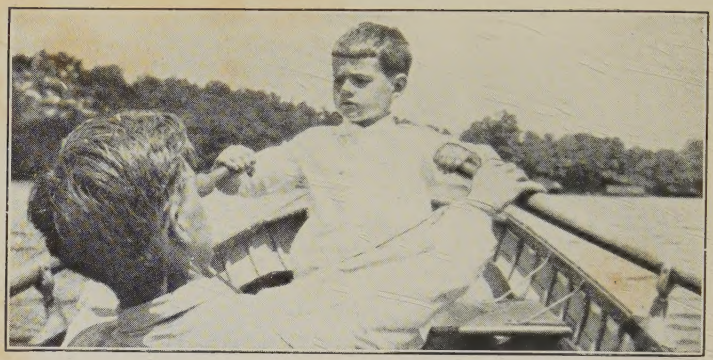

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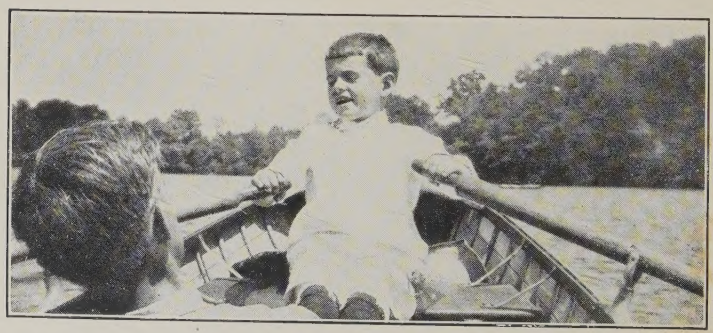

3. Success and Exultation

STAGES IN THE LEARNING PROCESS

AMERICAN EDUCATION SERIES

GEORGE DRAYTON STRAYER, GENERAL EDITOR

PSYCHOLOGY FOR TEACHERS

BY

DANIEL WOLFORD LA RUE, PH.D.

AUTHOR OF "THE SCIENCE AND THE ART OF TEACHING"

AMERICAN BOOK COMPANY

NEW YORK CINCINNATI CHICAGO

BOSTON ATLANTA

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LA RUE — PSYCHOLOGY FOR TEACHERS

E. P. 9

EDITOR'S INTRODUCTION

THE laws of teaching are based upon the science of psychology. Curricula for the professional training of teachers have long included courses in this science. During the past fifteen or twenty years very great advance has been made by means of investigations in this field. The results that have accrued have, in part, been unavailable for teachers because of the general nature of the treatises on psychology. The need has been for a book which would bring to bear upon the problems of teaching the principles of psychology and their special applications as they have been derived by recent investigations. This book fulfills this need in a remarkable degree.

The author has presented for teachers in the first part of the volume a broad outline of the subject in a way that will give the teacher a feeling of confidence in dealing with the more detailed study which follows. In presenting the applications of psychology to the problems of teaching, Dr. La Rue has proved himself a skillful teacher. It will be observed that the study of any particular principle begins with the statement of a problem to be solved, and that the subject under consideration is developed with a wealth of illustration and with a degree of concreteness in presentation that is most unusual. At the end of each chapter are topics for further study, and exercises to be solved as a means of testing the reader's knowledge and his ability to apply the principles which have been discussed.

Everywhere the author emphasizes the application of the psychological principle to teaching. Students in normal schools or colleges, or teachers at work in classrooms will find in the pages of this text, not only an interpretation of the fundamentals of teaching practices, but also many helpful suggestions for the solution of the actual difficulties encountered in their profession.

GEORGE D. STRAYER.

PREFACE

We appear to have applied psychology to the teaching of every subject except psychology itself. In this direction, there is large room for development. One of the chief purposes of this book is to present psychology psychologically.

Usually, all the student's work before beginning this subject has been objective. To plunge him headlong into subjective phenomena is too much like the method of teaching swimming by throwing the learner overboard. "From the known to the unknown": the old rule holds.

The method here adopted consists in (1) passing from the familiar picture of man in his common environment to a study, with genetic sidelights, of "Body, Brain, and Mind," (2) showing the relation of adjustment between "The Mental and the Environmental," and (3) explaining, in the study of "Mind, Nervous System, and Behavior," how the neuro-mental governing and steering system accomplishes its complex task of adjustment. In this way we complete the sensori-motor circle, inward from body to mind, outward from mind to behavior.

The frequently found plan of isolating the discussion of the nervous system in a separate chapter has not been followed. Such knowledge is better assimilated and applied if presented in direct connection with the most closely related mental facts.

In Part One, which gives an airplane view of the entire science, causing its larger features to stand out, there are developed a few simple laws which, applied throughout the book, effectively organize and simplify the whole complex subject.

Part Two shows a nearer and more detailed view of the facts, such facts as *teachers* most need to know. The final chapters synthesize what might otherwise remain fragmentary knowledge, into a unified study of personality, mental hygiene, and mental efficiency.

My debts are too many to mention — save one, that to my wife, my kindest and most merciless critic.

D. W. L.

CONTENTS

PART ONE

A SIMPLE, GENERAL VIEW OF MIND AND BEHAVIOR

CHAPTER		PAGE
I.	The Nature of Psychology	13
II.	Body, Brain, and Mind	25
III.	The Mental and the Environmental	41
IV.	Mind, Nervous System, and Behavior	54
V.	Nervous Channels and Mental Currents	72

PART TWO

A MORE DETAILED STUDY OF MIND AND BEHAVIOR

VI.	What the Mind is Made of	91
VII.	Gathering Experience: Hearing and Seeing	104
VIII.	Gathering Experience: Impression and Perception	120
IX.	Recording and Reproducing Experience	136
X.	Analyzing and Associating	160
XI.	Imagery and Imagining	179
XII.	Thinking	198
XIII.	Affective Experience: The Feelings	220
XIV.	Affective Experience: Types of Behavior	242
XV.	Individuality and Individual Differences	256
XVI.	Striking Variations of Personality	271
XVII.	Mental Hygiene and Mental Efficiency	290

PART ONE

A SIMPLE, GENERAL VIEW OF MIND AND BEHAVIOR

PSYCHOLOGY FOR TEACHERS

CHAPTER I

THE NATURE OF PSYCHOLOGY

Exercises. — 1. Before reading this chapter, write what you can on the topic, "What Psychology Means to Me." Include a statement of what you think psychology should do for you as a teacher.

2. Write a few paragraphs on the subject, "What I Thought and How I Felt When . . ." Let the "When" introduce some event that affected you considerably. Perhaps "When I First Spoke in Public" would serve well.

"What is psychology like?" "What is it good for?" These are the questions in your mind as you open this book or enter the psychology classroom. "In your mind" — that takes us into psychology at once: for everybody has heard the rumor that psychology is the study of mind.

The place of psychology among other branches. — We can group all branches of study in a simple plan, as shown in the figure. Psychology falls in with science. But there are two kinds of science, physical and mental.

Physical science deals with the world as it would be without mind in it. For example, when you study Physical Geography, you study a mindless world of rock and wave, storm and sun, volcanoes and vegetation. Psychology has no place there.

But put man — and hence mind — into this world, and with him enters psychology, the study of mind, of love and hate, of remembering and forgetting, of pride and fear and courage, of thoughts and feelings in general. Psychology is an extremely personal science. In fact, we may almost call it the science of personality.

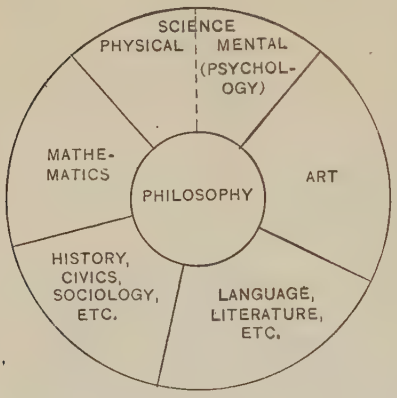


FIG. 1. — Showing the relation of psychology to other branches.

Biology and physiology are the physical sciences which lie nearest to psychology and influence it most. Biology is the science of life. Now, there can be life without mind; at least, such minds as ours. Plants, insects, and our own sleeping, mindless but living bodies, are examples of it. But there can be no mind without life. So far as we can see, life is necessary as a supporter of mind.

The sciences may well be pictured as resting on each other in layers, strata, stories, with physics forming the foundation. But if psychology is the top story of the sciences, it is not a mere garret, a dark stow-hole for ghosts, hypnotism, and spiritualism. It is as orderly and well kept as any other scientific suite; its elevation gives it a wide view; and it opens to the free sky, to the larger truths of life.

PSYCHOLOGY
PHYSIOLOGY
BIOLOGY
CHEMISTRY
PHYSICS

Physiology and psychology have some ground in common; in fact, it is not always easy to tell where one leaves off and the other begins. There is even a dispute as to whether psychology is not properly a part of physiology. We shall probably be unable to settle this dispute until we have more knowledge. If we should stop breathing for ten minutes in order to observe what would happen, we, our minds, would no longer be there to observe. So, too much or too little food, or work, or play, or sleep, changes our minds so much that, if we could photograph them as we do our faces, we should not recognize ourselves.

How to find the nature of a science. — Whenever we find any work going on — for example, men building something — we can learn the nature of it from the answers to a few very simple but very important questions: 1. What is the one big purpose of the whole business? What is it *for?* 2. With what kind of material are the workers busy? 3. What is their method of work? 4. Finally, what comes out of it? What good is it?

So, whenever we find a body of scientists busy at building a science, we can learn its nature by finding out these four characteristics:

1. Purpose.
2. Subject matter.
3. Method of investigating.
4. Results.

We shall learn the nature of psychology by studying these four features of it. But before we take up the purpose of this particular science, let us glance at the "why" of science in general.

The purpose of science in general. — Why do we, the human race, study science? Because we want to live successfully, and the highway of science is the road to success.

Nature is at once our best friend and our worst enemy. She supports us; but she also destroys us. She indifferently furnishes our food, wrecks us with disease, provides us with fuel, terrorizes us with flood and earthquake and other disasters.

But she is orderly, regular, systematic, works "according to law," as we say. And science is just our effort to find out that law. In this way, we gradually get control of food supply, fuel, clothing, building materials, disease germs, and other determiners of our happiness and misery. And though our puny strength is insufficient to control the greater forces, such as those that cause climate, storm, flood, and earthquake, yet through science we are becoming wise enough to predict what is going to happen, and to shape our course accordingly.

The purpose of science in general, then, is prediction and control of events, as a means to human happiness. Of course, there are those who follow science for the sake of science, just as others follow "art for art's sake." Society, however, expects from science, not merely the pleasure of the scientist, but a contribution toward better living.

Purpose of psychology. — Psychology aims to predict and to control *mental* events. When a child is born, we wish to predict, from our knowledge of its ancestors, what kind of mind it will develop. As the child grows older, both parents and teachers want to control its mental opera-

tions. Many a teacher fails to keep order; and yet discipline is a matter of psychological control. The physician needs to understand the mind of his patient; the minister, the sin-sick soul; the lawyer, his client and his witness; the salesman, his customer; the wife, her husband; the husband, his wife; the orator, his audience; the statesman, his people; and Everyman, how to control himself: for "better is he that ruleth his spirit than he that taketh a city."

Subject matter of psychology. — The subject matter of psychology consists of thoughts and feelings — using these

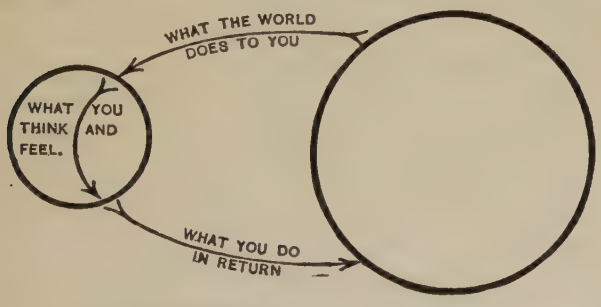


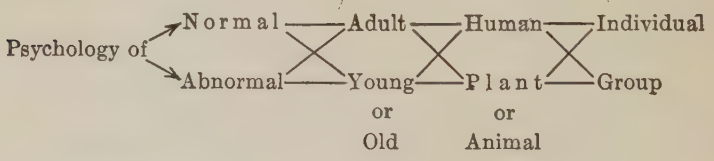
FIG. 2. — Showing how mind stands between stimulus and reaction.

terms rather loosely. These thoughts and feelings stand between what is done to us and what we do in return. Let us picture the world and the individual as in the figure (Fig. 2). "What the world does to you" that arouses your thoughts and feelings, is called a *stimulus*. "What you do in return" is your *reaction*. Thoughts and feelings form a very important link between stimulus and reaction.

For example, an old friend passes you on the street, with averted gaze. If you feel this as a slight, you may take social vengeance, cut him off your party list; but if you think his eye chanced to miss you, you hail him at next meeting as cordially as ever.

Psychology is made more interesting by the varied reactions of different individuals. Punish one pupil, and he thinks it over and reforms. Another feels that you have personally insulted him, vents his spite on you, and behaves worse than ever. A third seems too callous and stupid to think or feel anything.

Branches of psychology. — Mind of some sort is found in creatures of many kinds, and under a variety of conditions, sane, insane, aged, infantile, human, animal, and so on. The study of all these types gives rise to a number of kinds of psychology, which Yerkes [1] has arranged in an ingenious diagram, as below.



Each term in the upper line is contrasted with the one directly below it. To name the various branches of psychology, start at the left and pass toward the right along any horizontal or oblique lines until you have included four terms. Thus, the psychology of the normal, adult, human individual is ordinary, "general" psychology, just what we are now beginning. The psychology of the

[1] Robert M. Yerkes, *Introduction to Psychology*, p. 17.

normal, young, human group, is the psychology of children as they work or play together.

In addition to all these divisions, there are other branches of psychology which answer special purposes. So, physiological psychology traces the relations between physiology and psychology; comparative psychology compares the minds of various animals including humans, perhaps; genetic psychology shows the genesis, or development from the beginning, of mind in an individual, or a species, or even the whole worldful of living creatures. Very important for the teacher is educational psychology, which traces the laws of the growing mind and helps us to adapt the lesson to the learner.

Method in psychology. — The general method of finding out truth is the same in all sciences. The process consists of three very large and important steps:

1. Get the facts.
2. Form a theory.
3. Test the theory.

Take an example. The water in your pitcher is sometimes warm, sometimes cool, to your hands, when you can find no cause for its changing temperature.

1. You collect facts, take the temperature of the water with a thermometer, note whether your hands were warm or cool just before being immersed, etc.

2. After careful thought, you conclude that water of unchanging temperature seems warm or cool according to the temperature of the hand that enters it.

3. As a test, you hold your right hand in cold water, the left in hot water, for a few minutes, then plunge both into

water that is lukewarm. It seems warm to the right hand, cold to the left.

This is a simple illustration of the general method of investigation followed in all sciences — first facts, then thinking, theorizing, and back to the facts again.

Of course, the facts are always acquired by observation. And just here is what makes psychology seem "queer" on first acquaintance: probably all the other sciences you have studied — geography, botany, and so on — have directed your observation to things outside of you, to flowers, rivers, rocks, to what-is-not-you. Even physiology gets no farther than your body. But now, you shall observe what goes on in your mind — your thoughts and feelings, your mental self. It is somewhat as if a camera, having hitherto centered all its efforts on photographing everything around it, should begin to take pictures of what goes on within.

The mind's observation of itself is called *introspection*. There is no great mystery or difficulty about it.[1] Ask a small boy if he is hungry, and he must introspect before he can tell you truly. Every time you answer the question, How do you feel, or describe your symptoms for your physician, you do it by introspection. If you performed the experiment with the three bowls of water, as described above, you found your verdict as to the temperature of the water by introspection. There is no one who does not observe his mind, in some fashion, carelessly or carefully, every day. Psychology simply requires that you observe

[1] "The most frequent impediment to men's turning their minds inward upon themselves, is that they are afraid of what they shall find there." S. T. Coleridge, *Aids to Reflection*, p. 124.

mind carefully, just as botany demands that you observe plants carefully.

Results of psychological investigation. — Perhaps the chief result of studying psychology has been to convince us that there *can* be results. Mind is no longer regarded as a sealed mystery, an irresponsible, self-sufficient thing, defiant of law. We should be greatly surprised if fire burned us to-day and froze us to-morrow: the natural world "works by law." Mind, too, works by law. "I chanced to think," you say. "No," interrupts the psychologist; "not if you mean that it really happened by chance; for nothing ever happens by chance in the mind any more than it does outside the mind." And he proceeds to explain to you the laws of your thinking. True, his range and accuracy of prediction and control are not yet so great as in certain other sciences. This is partly because psychology is young as yet, partly because its facts are often complex and difficult to get at.

One of the chief results, then, is that science, entering the last corner of the universe to be explored, the mental corner, finds everything orderly, regular, systematic here, as elsewhere.

If we look for the more practical, everyday benefits of psychologic study, the chief difficulty is, not to find them, but to find any human situation where they are not, or at least, cannot be. In home life, in court, in asylum, church, schoolroom — in all personal culture and in all social usefulness, this science of mental personality is helping us to deal with persons.

CLASS EXPERIMENTS

The purpose of these exercises is to get practice in introspection.

1. The instructor will announce some simple task, such as, "Write the alphabet backward." Each will observe and report on the way his mind works during the process.

2. Let the instructor display together several full-page advertisements (perhaps mounted on cardboard). Each will select the best-liked and the least-liked. Report of reasons for likes and dislikes. What practical help is there here for the advertiser?[1]

3. Outside of class, let each make some small purchase, noting the effect on him of the store, its lighting, cleanliness, arrangement; the clerk's courtesy or lack of it; the appearance of the package and the quality of the goods.

Class report and discussion. "Shall you buy there again?" Why or why not?

FOR FURTHER STUDY

1. Write ten questions which you think psychology should answer.

2. Arrange two columns, headed "Physical" and "Mental," respectively. Make a number of entries in each. Compare the two sets of entries and try to make statements about them.

3. If the study of animals is included in physical geography, is there then anything mental about it? Try to prove your answer.

4. Try to find some difference between life and mind. If one loses his mind, is that the same as losing his life?

5. State the purpose, subject matter, method of investigating, and the chief results, of some science you have studied.

6. Philosophy is an attempt to gain a comprehensive, unified view of the universe. Do you think psychology has any more to do with it than has any other branch?

[1] After trial of these advertisements on a few classes (totaling, say, 100 students) the teacher will be able to state in advance which will stand first, which last, in the choice of succeeding classes — a simple case of psychological prediction.

7. Predict what answer you will get from a friend if you ask him a certain question — perhaps whether his candidate will win the next election. Try it out, telling him nothing of your purpose. Compare the result with your prediction.

8. One author, on reading the first part only of another's book, has been known to predict correctly how the characters would turn out. How is this possible?

9. Novelists assert that a character, once he is introduced, insists on behaving as he will — the author cannot control him. How is this?

10. Describe, that is, name, according to Yerkes' scheme, the psychology of an old man; of a lamb; of a group of insane men and women; of a mob; of your psychology class.

11. Look up the derivation of the word introspection. Do the meanings of its roots seem to you to fit the case?

12. What advantage is there, when one is ill, in being a skilled introspector?

13. "Just put yourself in my place and tell me what you would do." Is this possible? If so, what does it require?

14. Describe some experience of your early school days. Of what use is it to a teacher to be able to bring back his own school experience vividly by introspection?

15. Observe the influence of work, play, sleep, eating, deep breathing, etc., on your mental condition, and report what you find.

16. Picture the world as it would be if suddenly deprived of all scientific knowledge.

17. Are there any difficulties in observing thoughts and feelings, that are not found when we observe the outside world?

18. Is psychology any more closely connected with teaching than it is with preaching, or practicing law?

19. State differences you have observed in people with regard to spending money, attending church, studying, pleasure-seeking, paying attention to the other sex, etc. What do you think psychology can do in the way of prediction and control here?

20. Working either alone or in class, make a summary, for your notebook, of the facts in this chapter which you think it worth while to memorize. Try to write short, crisp, meaningful sentences.

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CHAPTER II

BODY, BRAIN, AND MIND

" The centipede was happy, quite,
Until the toad, for fun,
Said, ' Pray, which leg comes after which? '
This worked her mind to such a pitch
She lay distracted in the ditch,
Considering how to run."

Exercise. — Do you believe the centipede ever spends any time considering how to run? What do you think as to its moving each leg with deliberation? What keeps the legs moving with such regularity and speed? Where or what is the controlling apparatus? What could you do to the centipede so as to interfere with its leg movements without injuring the legs themselves? If you know of any lower animals or human beings that have suffered loss of movement in any part without direct injury to that part, tell of such cases.

Do you think the centipede ever tries to explain your movements as you do its running? Why? Would it have more or less to explain? What is the chief difference between you and a centipede so far as behavior is concerned?

The body is like a city. — One who carelessly observes a city may regard it as a confused collection of corners, big buildings, streets full of people and vehicles, cars, noises, and bumps. But as he studies the chaos, he finds it composed of systems, working, for the most part, harmoniously.

First of all, a city must be fed. Consequently, it has some sort of feeding system; food enters from somewhere and is laid before the buyer in store or market. Further, since people must get about and goods must be transported,

a transportation system is necessary, streets, car lines, taxicabs, delivery wagons. To dispose of the waste, there is a sewage system. Over all, there is a system of government. If this governing system is efficient, it receives quick news from everywhere and enforces its ordinances from center to suburb in the interest of all.

So, a human body, at careless glance, may seem a planless collection of parts; but physiology shows us that it is a well-organized group of systems, a system of systems.

Man as a group of systems. — Man, like every other living creature, is first of all a feeder, an eater; hence his digestive system. To carry the digested food about the body requires a circulatory system. To keep the blood stream of the circulatory system pure, there is a respiratory, or breathing system. To remove waste matter, we are provided with an excretory system — lungs, skin, and kidneys. And since nature has not made the body immortal, it must reproduce its kind; hence the reproductive, or sexual system.

These five systems, digestive, circulatory, respiratory, excretory, and reproductive, are often called the *vegetative* systems, because they are all found, in some form, in plants. Plants feed, circulate their sap, breathe, excrete waste matter, and reproduce their kind. Perhaps it is more enlightening to call these five systems the *supporting*, or *maintenance* systems, because they merely support, or maintain, the bodily machine. They simply enable the plant or animal to keep alive so long as conditions are favorable. But as they do the inside work only, of the body, they do not put it in touch with the great world outside. In fact, a creature that has maintenance systems

only, such as a geranium, does not even know that there is an outside world, an environment on which its life absolutely depends.

Now, most animals have two more systems, most important of all to us as psychologists. These are the muscular and the nervous system. If the conservatory becomes cool, the cat goes elsewhere to find warmth; but the geranium sits still and quietly freezes to death. Why? Because it has no muscular system and so can not move itself about. But further, it lacks the animal nervous system, and so does not know that it is cold, or have any *wish* to move about.

These two systems, the muscular and the nervous, are sometimes called the *animal* systems because (speaking generally and roughly) animals have them and plants do not. It is better, perhaps, to call them the *adaptive* systems, because they enable the animal to adapt itself to its surroundings. So the cat leaves the cold conservatory and hunts a warmer environment. But we, having better nerves and muscles than the cat, can surpass her in power of adaptation, can *succeed* better — for that is what adaptation amounts to: we do not go to the heat, but bring it to ourselves by turning the damper of our furnace.

As teachers, we are especially interested in the adaptive systems, for we may almost say the pupil *is* his nerves and muscles. The nervous system feels, experiences, what the world does to him; his muscular system carries out, vigorously or weakly, skillfully or clumsily, his reaction. Given good nerve and muscle and we have a good pupil. And if we ever succeed in educating him, it will be by training his adaptive systems, in other words, his *success* systems,

his nervo-muscular or (as it is more commonly called) neuro-muscular apparatus. For instance, when we teach a child to write, we first print on his brain a picture of the letters and the movements he is to make, and then train his muscles to make them. This process goes on as long as we learn — and that should be as long as we live: the world beats its lessons into our brains, and we in turn try to show by what we do, by the use we make of our muscular systems, that we amount to something in the world, and can perhaps even influence its tough constitution.

The nervous system is the governing system of the body. — As in a city all departments are subject to the city government, so in the body all other systems are subject to the nervous system. Stomach, heart, lungs, muscles — every part of the body reports to it; and from it are sent out nearly all orders for the transaction of the body's business. Even to sense a fly on one's cheek and to swat him for his impudent invasion, brings actively into play some part of this supreme system of the body.

And not only does the nervous system suffer with the others, as when a decayed tooth or an inflamed lung causes pain; and rejoice with the others, as when we "feel fine all over"; but it *teaches* all the other systems, gives them training and discipline so far as they are capable of receiving it. For example, if we wish to form the habit of deep breathing, it is the brain that drills the lungs into their proper habit. But, speaking generally, the behavior of the maintenance systems can not be changed very much: heart, lungs, and stomach, behave about the same at death as they did at birth. Not so with the adaptive systems: it is chiefly in muscle and brain that the adult differs from

FIG. 3. — Showing how the nervous system, the governing system of the body, is distributed throughout its bulk.

the child. Yet all nicety of muscular action merely pictures for us the fine performance of the brain cells, boxed out of sight in the skull.

To teach a child is to change his nervous system so as to make it work better. The aim of education is the production of the best possible nervous system.

What if there were no nervous system? — To find out what a thing is good for, take it away and see what happens. Let us consider an animal to which nature has given no nervous tissue.

Fig. 4. — Diagram of a sponge.

The sponge (see the figure) is such an animal. In the numerous pores that lead from the outside of its body to the large cavity within, are many cilia, or hairlike muscles, which lash the water and cause it to flow inward. Ordinarily, it then passes out through the opening at the top. Around this opening is a muscle which, when stimulated, contracts and prevents the water from escaping. Yet, in such a case, the cilia go on thrashing the water and vainly trying to force it inward. This is as foolish as if a man should try to build a brick wall by laying up bricks with one hand and pulling them down with the other. If man had no nervous system, he would probably try, sometimes, to walk in opposite directions with his two legs, or start a fight between his two fists.

The primitive nervous system. — Any animal that remains fixed to one spot, as the sponge does, has less need

of an adaptive system than does one that undertakes to guide itself freely about its environment and find its food. Such a creature, without sense organs, would bump into its surroundings and flounder into danger on every hand, to say nothing of missing many a good meal. Nature's way of meeting this emergency is to develop around the bumping spots and the food-finding end of the animal, cells sensitive enough to receive impressions from the environment, in other words, nerve cells. These nerve cells enable it to get advance news of whatever is about, flee the bad and seek the good.

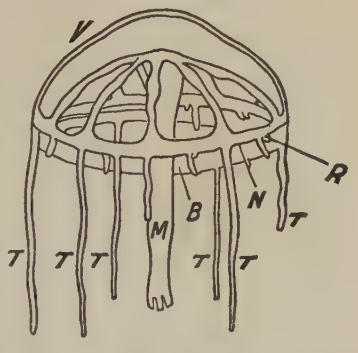

FIG. 5. — The jellyfish. *V*, umbrella; *B*, circular band, containing *N*, a ring of nervous tissue; *R*, a sense-organ for touch; *T*, tentacle; *M*, mouth stalk.

The jellyfish is one of the humblest creatures that attempt to explore the environment in this way. It lacks eyes and ears, but has sensitive cells around the rim of its body and in its tentacles. From these sensitive cells, nerve fibers branch off, forming a nerve-net that runs all through its muscular system. Whenever one of these sensitive cells is stimulated, a nerve thrill, or impulse, runs from it through the nerve fibers to the surrounding muscles. The stronger the stimulation, the farther the impulse travels, until all the muscles of the body are set into motion. The result is that, whether swimming or feeding, all its muscles work well together, are well coördinated — quite a contrast to the sponge.

It is evident that the nervous system controls, whether in jellyfish or man, by connecting and unifying the various parts of the body.

But the jellyfish is a stupid creature, after all. It has no brain.

Growth of the brain in animals. — The study of the lower animals helps us to understand ourselves, for in many respects the same plan of structure runs through all. At first, the segments of these lower animal bodies were largely independent, each having its own sensori-motor arcs, that is, "arches" of nerve running from sense organ to muscle, and each its own ganglion.[1] (See the figure.) But such an animal has to move; and it is not round, like a jellyfish, and so it cannot strike off indifferently in any direction: it has ends, and one of these ends must go first. Since the creature is moving largely to find food, it is natural that the mouth end should go ahead. Now, this roaming mouth needs the best guidance possible. What better place for the senses of taste, smell, hearing, and sight, than the region around the mouth?

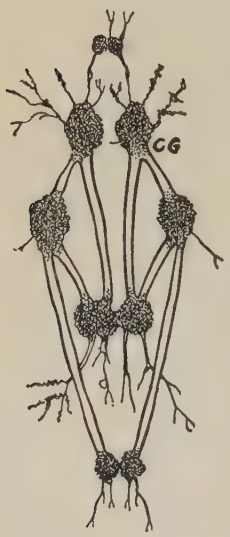

FIG. 6. — Diagram of the nervous system of the earthworm. *CG*, the cerebral ganglion, or "brain," the master ganglion of the nervous system.

But every one of these sense organs must be connected with every muscle of the body. If, for example, the eye

[1] A ganglion is a group of nerve cell bodies, with their branchlets — a kind of connecting center for the nerve fibers. The plural is ganglia.

reports food in front of the animal, a nerve thrill must pass from that eye to every body-moving muscle to insure full speed ahead. And there must be an equally widespread distribution of nerve impulses to secure united action of all muscles in beating a retreat. Now, all this means multiplication of connections, of nerve fibers, and as we should expect, most of them appear in the most convenient place, near the sense organs, in the head. So begins the brain.

Thus there come to be grouped, in and about the bony-armored head, the mouth, the special sense organs, and the brain. To sum up: the mouth end of the animal not only *goes* ahead, but *grows* a head, with a brain in it, and set round with the most delicate and precious sense organs.[1]

What does the brain do? — The brain is the master ganglion of the body, the chief member of the most important bodily system, the governing system, the steering system. We can sum up its business pretty well under two heads:

1. It stores experience.[2]

2. It gives every part of the body the direct benefit of this stored experience.

1. This stored experience takes the form of memory — using the term in a wide sense. The brainless jellyfish probably has no idea of what he did yesterday. He reacts to each knock of his environment without knowing whether the same visitor ever knocked before. Not so man: the records of his experience lie there in his brain cells, as the life records of the city are found in the archives of its

[1] See W. McDougall, *Physiological Psychology*, pp. 18, 19.

[2] Of course, this is a figure of speech. It is much like saying that a phonograph record "stores" the music which it can reproduce.

council chambers. This is precisely why he can be educated so easily and induced to shift his course to fit the future. But any teacher would have hard labor trying to discipline and instruct a school of jellyfish!

2. In the jellyfish, there is not only no central office of intelligence, but there is no switchboard method of connecting organ with organ directly. If a nerve impulse starts at any point, it has no private wire on which to travel, but must spread, like rumor on a country telephone, whereever the wires are open. The human brain is a switchboard wherein hundreds of millions of "wires," that is, nerve paths, shift their messages.

Now, learning anything is just a matter of making new paths, or perfecting old ones, in the nervous system, especially the brain. A man who had been brought up in the East, took a trip to that part of the West where cactus is abundant. One day, losing himself in the pursuit of some creature he was trying to capture, he pushed vigorously into the midst of an equally vigorous cactus bush. Said he, "That sharp experience taught me to let the cacti alone. I never assaulted a cactus bush after that." This means that the sight of a cactus ever after discharged his brain currents over a new path and made his muscles carry him away from the bush instead of into it.

A child sees a candle for the first time and touches it. (See the figure.) This means that a nervous impulse runs from the eye to *C*, the candle cell, and out to the muscles of arm and hand. The resulting burn sends in another nervous current which thrills both *C* and *B*, the burn cell, at once, and so sets up a path between them. Next time the child sees a candle, the impulse which arouses *C* passes

to *B* also, causing him to remember the burn and restrain the natural tendency to touch.[1]

Here is stored experience, made available by improved switchboard connections, for the protection of the body. Had these individuals had the nervous system of a jellyfish, they would have gone on blundering into danger many times more.

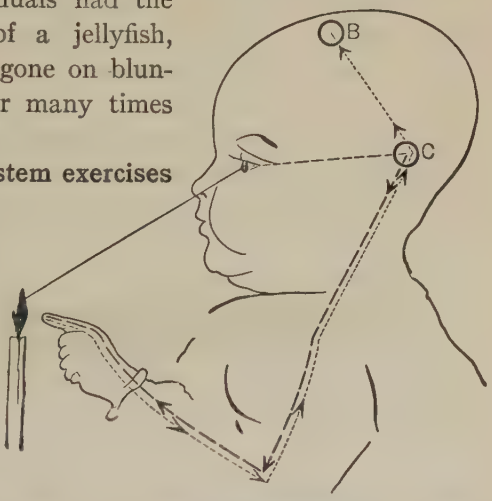

Fig. 7. — "A burnt child fears the fire." Dotted lines indicate impulses running into the brain; the dash line an impulse passing out to move the muscles.

The nervous system exercises two kinds of control. — When our friend ran into the cactus, he knew perfectly well that he wanted to get out: there was (1) conscious control. But he probably knew nothing of his heart's beating or his breathing; he may even have said something without knowing it. Yet his nervous system controlled all these matters, too. Here was (2) unconscious, automatic control.

Some of the lower animals exhibit automatic control to a

[1] This account is simplified as compared with what actually happens. For a complete statement and cut, see James's *Principles of Psychology*, vol. I, pp. 24–27.

nicety. Competent observers assure me that chickens are sometimes known to run when their heads have been removed. Certainly, a creature so low as the centipede does so readily. Cut off a centipede's head while the animal is running, and its hundred legs, bearing the headless body, run on without confusion. Cut its length into several fractions, and each fraction does the same. If the headless body meets a low obstacle, it mounts over the obstruction; if a high one, it is stalled dead against it, but still the legs keep up their motion. Cut the ventral cord, a cable of nerves corresponding to our spinal cord, thus

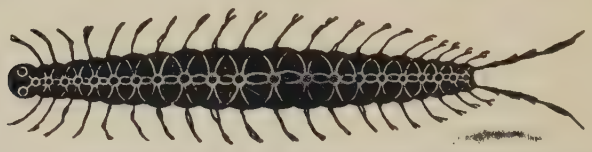

FIG. 8. — A centipede, showing nervous cord, with ganglia, and master centers in the head.

severing all nervous connection between head and hind legs, and the front legs will have one motion while the hinder ones show another. The reason, of course, is that the tiny brain still controls the front legs, while the rear ones are directed by their own ganglia only. If the cut is so placed that this rear portion of the body is the larger and stronger, it may even carry the head where that head does not at all want to go.[1]

Now, the psychologist is interested in behavior of all sorts, but more especially in consciously controlled behavior, and most especially in the consciousness, the

[1] See William B. Carpenter, *Mental Physiology*, pp. 53, 54.

thoughts and feelings, the mind which does the controlling. Where is the mind found?

Mind dwells in the brain. — The mind, sometimes called the soul, has been variously located by different observers, in the breath, in the heart, and elsewhere, sometimes in the body as a whole. "Joseph's bowels yearned for his brethren"; "bowels of compassion"; "Cupid's dart has pierced my heart"; "hot-blooded"; "white-livered"; "spleeny"; these and many other phrases suggest that the mind is located in, or strongly influenced by, certain bodily organs.

When we touch an object, we may even feel that we are in the hand, doing the touching. But if we cut the nerves between hand and brain, we no longer "feel" it when the hand makes contact with objects; and though we can determine to move the hand, we are unable to do so. Yet the brain can still think of the hand; and if we stimulate the cut end of the nerve leading to the brain, we get sensations that seem to be in the hand. And this is true even when the whole hand has been cut off. The hand-experience, then, is really in the brain.

This explains the many stories of a phantom limb, wherein the owner of the limb seems to be conscious of it, or even tries to use it, after it has been amputated: the brain continues to behave as it got into the habit of behaving while the limb was attached.

There are at least two great lines of evidence that make us believe the mind is in the brain. These are (1) brain development and (2) brain pathology (injury, disease, or decay).

(1) In general, mind and brain develop together. Man, the first of all animals in mental development, excels also

in complexity of brain, and (with a few exceptions) in brain weight as compared with body weight.[1]

(2) A surgeon can open one's skull and, by moderate pressure on the brain, cause consciousness to vanish. If he removes a certain center in the back part of the brain, the owner of it cannot see, though his eyes are unharmed, and he is still "in his senses," — the remainder of them. An inflamed brain may cause insanity; a bloodless one, fainting. When the brain shrinks and decays because of old age, the mind also is affected.

These, and a host of other similar facts, convince us that the mind dwells in the brain.

CLASS (OR INDIVIDUAL) EXPERIMENT

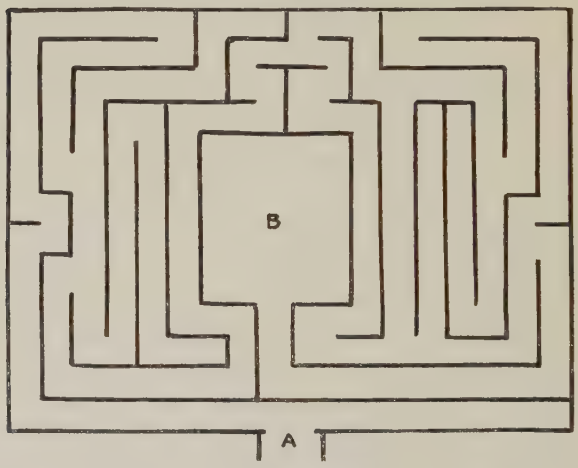

FIG. 9. — Plan of the Hampton Court Maze.

Figure 9 shows the plan of the Hampton Court Maze, which has served widely in experiments on lower animals and human beings.

[1] See Ladd and Woodworth's *Elements of Physiological Psychology*, p. 34.

The problem is to find the way from the entrance to the food box without back-tracking.

Do not try it, nor study the maze, until told by your instructor to do so.

Your problem is not so much to find the way to the food box as to observe how your mind behaves when you undertake such a task. How do you decide which way to start? How do you feel when caught in a blind alley? Notice how the experience is stored to help you past that point next time.

Trace your path with something that leaves no mark, such as a toothpick. How many trials are required before you can go directly to the food box?

Write a brief introspective account of the learning process.

FOR FURTHER STUDY

1. Describe the behavior of a human being as you think it would result if he had no nervous system.

2. Would a sensitive nervous system and sense organs like yours be a blessing or a curse to a plant, if it had no muscular system? Why?

3. Give numerous instances of adaptation, the successful fitting of conduct to circumstances, involving the nervous and muscular systems.

4. Give instances of friction and failure owing to lack of adaptation. What do you think was the matter in each case?

5. "To teach a child is to change his nervous system so as to make it work better." Try whether this is true in reading, arithmetic, spelling, manual training, etc.

6. Have you noticed in yourself any lack of muscular coördination in your work or play when fatigued? Can you hit a croquet or tennis ball just as well? If not, suggest a reason for the poor control.

7. Compare, with regard to sense organs, the heads of various common animals, such as the earthworm, the centipede (the house centipede is blind), the snail, the grasshopper, the snake, the sparrow,

the cat. Do you suppose human heads, 10,000 years from now, will show any change in size?

8. Make a rough drawing to suggest the possible course of the nervous currents in the case of the man who learned not to run into cactus bushes.

9. Tickle, prick, or pinch the hand or foot of a sleeping animal, human or lower. Explain what happens. Do you think the nervous current in this case reaches the brain? Why?

10. List all the phrases you can find which indicate that the mind is located in, or influenced by, certain parts of the body.

11. (*a*) "Cupid's dart has pierced my heart." (*b*) "A dart from Cupid's quiver has pierced me through the liver." (*c*) "Oh! the sweetness of the pain, since Cupid shot me through the brain." Which of these is most truthful? Which would you place on a valentine? Why?

12. As a child's stomach increases in size, his mind develops. How do you know the mind is not in the stomach?

13. Discuss the extent to which one can exert conscious control over the various systems of the body. Do you think one's ideas may aid or hinder digestion? Why?

14. A feather, used to tickle the back part of the mouth in order to produce vomiting, is sometimes seized by the muscles of the throat and pulled out of the fingers of the physician or other person who holds it. Explain this.

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CHAPTER III

THE MENTAL AND THE ENVIRONMENTAL

Exercises. — 1. Which of the following words refer to the physical world? Which to mental processes? Which may refer to either? Stone, memory, fluid, anger, fire, sound, moon, darkness, voice, color, thought, taste, smell, horse power, touch, heat.

2. Would there be any "sound" when a tree fell in the wilderness if no living creature was there to hear it? (Be sure that you know what you mean by *sound*.)

3. Imagine a peculiar pencil — perhaps one with two points, or one that leaves a thread of gold wherever it writes. Can you put into the imagined pencil anything that you have not experienced at some time with your sense organs? (For example, you have seen golden threads.)

Nature and human nature. — All the world, so far as we know it, may be divided into two parts, nature and human nature (including the minds of animals). We are apt to feel that there is quite a contrast between winds, rivers, and stars on the one hand, and on the other, the mind that observes all these things and thinks about them. A few of the points in such a contrast may be summed up as below:

Nature	Human Nature
1. Environmental, physical.	Mental.
2. Objects experienced.	Experience itself.
3. Seems not to know what it is about.	Is conscious: knows, for the most part, what it is doing.

Nature	Human Nature
4. Each object can be observed by many.	Each mind can be observed by itself only.
5. Made up of things and processes (as air, a thing; and wind, a process).	Composed of processes only (as memory and imagination).

The mental pictures the environmental. — We have seen that it is the business of the brain to store experience and hold it ready to use when needed for guidance. Were it not so, no one of us would know the way home. Now, experience consists largely of pictures of the environment. Let me ask you the way to your home, or your room, or the next town, and you probably find pictures of the turning points flashing through your mind.

As a psychologist, you must learn to make a sharp distinction between natural objects and your experience of those objects. Either may perish while the other survives. You carved your name on a tree years ago. The tree may be gone but the experience is still stored in your brain. Or perhaps you have entirely forgotten the toy which your mother keeps, and with which, as she tells you, you played in childhood. The object survives the old experience.

You are sitting at your study table. Close your eyes and you can still " see " the table there before you, as the child in school looks away from his spelling book and spells off a word from his mental photograph of it. So you can picture your home, or the ocean, or the " spacious firmament on high." Now, your experience is in your brain, but all these other things are not, any more than they are in the camera that photographs them.

Objective and subjective. — The psychological terms used to indicate the contrast between nature and human nature are *objective* and *subjective*. *Objective* refers to the object world, the world of nature; it means "pertaining to the object experienced." *Subjective* refers to human nature, and means "pertaining to the experience itself." So, your thought of home is subjective; the home (house) itself, objective. Your teeth are objective, your toothache, subjective.

We can always decide between the subjective and the objective by this simple test: Could the thing in question, under any circumstances, be observed by others, as even one's heart or stomach might be? or is it, like my thought or my heartache, observable by me only? Whatever could be thrown open to the inspection of all is objective; that which can be observed by introspection only, is subjective.

When in doubt as to whether a light or a sound is "real" or imaginary, we turn naturally to our companions and ask whether they see or hear it. Students often inquire whether Banquo's ghost was "really there." If several saw it, it was probably a real apparition — but not certainly so; for sometimes a whole crowd sees something which has no objective existence.

Psychology is the science of the subjective. — The subjective is the introspectable, and the introspectable is the mental. While there are other sciences, such as logic, that deal with mental facts in some measure, psychology is the only science whose purpose it is to describe and explain such facts in order to predict and control them.

Introspection. — Now (as stated in Chapter I) introspection is psychological observation, the mind's examination of itself. Without this, there could be no science of psychology, as we know it. Whoever can not introspect, can scarcely enter the outer court of the science. His progress in it will be in direct proportion to his introspective ability.

When a person undertakes to introspect, he should be, as Titchener says, (1) *impartial*, (2) *attentive*, (3) *comfortable*, and (4) *fresh*.[1] In fact, this should be true of all observation, outward or inward. But whereas there is no humiliation in telling the unvarnished truth about a stone or a flower, it sometimes hurts a little to report just what an impartial recording angel must see in our minds. We must brace up and tell the straight truth about ourselves, whether it exalts or abases.

The introspective habit, if it does not become morbid, is of great help in all practical affairs. A school director, explaining why a certain teacher failed, said, "She never seemed to be able to put herself in the pupil's place." Many teachers fail for this reason. Introspection enables teachers, as well as others, to put themselves "in another's place." Among the *Golden Sayings* of Epictetus, we find this: "The husbandman deals with land; physicians and trainers with the body; the wise man with his own mind."

You can introspect an experience from the past, in so far as memory can repeat it for you; or from the present, while it is on the wing. Try the first: close your book, summon some experience from the past, such as your

[1] See his *Primer of Psychology*, p. 34.

triumph in a game, your fall from a bicycle, or some childish love, center your whole mind on it and go through it in detail. This takes time, but it is worth the effort to a psychologist.[1]

Now try a fresh experiment. Fix your eyes on the upper point of the ghost's nose (Fig. 10) for about fifteen seconds, and then look off at a point on a light-colored wall or a sheet of white paper for a few seconds. Don't let your gaze wander from either point. Make notes of your experience.

FIG. 10. — A Hallowe'en ghost.

What is mind? — Mind is hard to define, but if any one wants a concrete example, we can tell him, "It is just what you are when you ask about it."

However, introspection shows that mind is a stream of happenings — something coming and something going constantly. Ask a friend to tell you when two minutes are up, and during that time, let the mental stream flow on, and try to count the different things you think of.

Mind, then, is not a *thing*, but a *process*. Things, speaking generally, remain unchanged, at least for a time, while a process *is* change. Water is a thing; the flow of water is a process. Air is a thing; wind, the movement of air, is a process. A wire is a thing; light, coming from a

[1] Samples from the work of other students are of great value at this point.

heated wire, is a process. The brain is a thing; mind, intimately associated with brain, is a process of some kind.[1] Just where the wind is when it is not blowing, where the light is when it is not shining, where the smiles are when we are not smiling, there, so far as we know, is where the mind is when it is not active, when we are not conscious. The mind of the dreamless sleeper has, for us, no existence, save as its "record" lies in the brain somewhat as the record of your phonograph music lies in the cabinet, ready for the next reproduction.

Mind is a stream of experience that flows from stimulus to reaction. It may move in deeps or shallows, now with meandering drift, now with the direct rush of a torrent; but its general course, from babyhood to the end, is ever the same.

The physical, the physiological, and the psychological. — Mind dwells in the brain, and so in the body; and the body dwells in the big world called the environment. We can picture this by circles (see Fig. 11). Mind, the psychological, has a physiological environment, namely, the body. The body has an environment composed of whatever you can point at around you, but which is, for the most part, physical.[2]

[1] Frequently, I shall use language which may seem to indicate that mind is nothing more than brain currents. I do not wish to imply anything about the relation between mind and brain. No one knows what that relationship is. But we are pretty sure that whenever the mind is active, there is corresponding brain activity. For brevity, then, and for the sake of presenting a concrete picture of the situation, I shall sometimes speak of brain thrills as if they were mental processes.

[2] Sometimes the word "physical" is used in a broad sense, and includes the physiological, as when we classify all things under two heads, physical and mental.

This physical world is full of energy, which beats the body constantly, as waves beat a ship. Things bump against us, heat waves roll at us without ceasing, sound waves pulse into the ear, and light waves vibrate through the eye.

The nervous system has end organs, receptors (that is, receivers), commonly called sense organs, which, being sensitive to these waves of energy, receive them and convert them into nervous energy, nerve currents, somewhat as a telephone receiver catches the waves of your voice and converts them into an electric current. But the telephone cannot catch light or heat waves in this way, because it is not "tuned" to them. So, each kind of bodily receiver, or sense organ, has been likened to a lock which can be unlocked by one key only, that is, by the kind of energy stimulus it is made to receive. The ear takes in sounds, but not colors; and the eye, light but not sound. Quite likely much in this world escapes us: quite likely there are many kinds of energy waves, other colors, sounds, and so on, for which we have no sense organs.

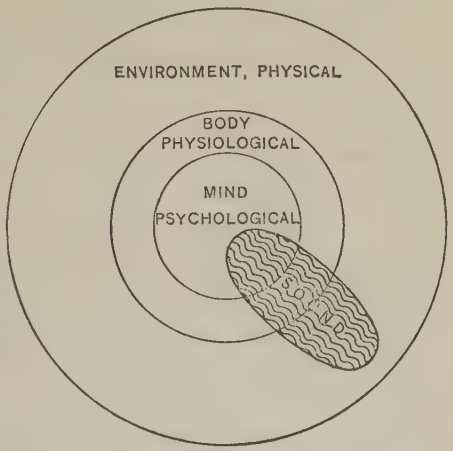

FIG. 11. — Picturing the relations of mind, body, and environment.

Physical, physiological, and psychological sound. — Tap on your table and consider what happens. The vibrating table starts vibrations in the air. Such vibrations constitute *physical* sound. Most of us believe that physical sound would remain in the world even if we were all dead, or asleep, or had no ears. Winds and waterfalls would still start vibrations.

Physical sound, when it reaches the ear, strikes a minute physiological harp and sets it to vibrating. This, in turn, sends through the nerve of hearing a thrill that reaches the brain. Such vibrations and thrills in ear and nerve constitute *physiological* sound. It cannot exist without an ear (or something like it); but most, if not all of it, can go on when one is asleep.

But you, wide awake, tapping the table, enjoy a kind of sound which your sleeping roommate does not get: this is *mental* sound, conscious sound, sound as consciousness, *psychological* sound. Such sound would not exist if mind were swept out of the world. No one knows just how physiological sound is related to the psychological, just where the boundary is between the two, just how a nerve thrill can start anything in consciousness.

Mind refers to the stream of experience from birth to death. *Consciousness* is mind at any moment, any cross-section of the stream of experience. A study consciousness differs from a theater consciousness, though both may be a part of the same mind at different times. But the two words are often used, roughly, as synonyms.

The mind is often made to seem more mysterious than it really is. Those who wish to prove its spirituality sometimes attempt to do so by saying that it has no weight,

occupies no space, etc. Neither does physical sound have weight or occupy space. Air and brains are *things:* they take room and have weight. Sound, of whatever kind, is a *process.*

Beware of wandering words! — In psychology, it is especially necessary to know just what our words mean; for as a rule, we cannot point to what we are talking about, as we can in many other sciences. In particular, we must keep these three circles of meaning (see Fig. 11) distinct. "Sound," as indicated, may have any of three meanings. So may *color*, *taste*, *smell*, and the like.

The brain is like a moving-picture factory. — The mental pictures the environmental, and the pictures are always moving. There is a striking similarity between the work of a moving-picture factory and that of the brain.

The moving-picture maker must gather his pictures through lenses. If he did not expose his films, he would have no pictures. The brain must gather its experience — much of it — through the sense organs. If it were never "exposed" (stimulated) by their action, the mind would remain a blank — there would be no mind.

The factory must store its films and bring them forth as needed. The brain stores experience and reproduces it on call. Both moving pictures and mental pictures may fade in time.

The factory cuts up films into sections and from these old pieces makes "new" pictures. The brain analyzes our experience into bits and makes new combinations of the old bits. So you can (mentally) behead a horse and cut a man in two, attach the upper portion of the man to the body of the horse and make a centaur. When Praxit-

eles was asked to make a statue of Venus, he selected the most beautiful parts of the most beautiful female figures he could obtain as models, and then combined these parts into one harmonious whole.

Finally, the moving pictures, good or bad, go out into the world. We express our *mental* pictures in our conduct.

To summarize:

The brain
(1) gathers experience.
(2) records and reproduces experience.
(3) analyzes experience, divides it up.
(4) synthesizes experience, makes new combinations.
(5) expresses experience in conduct.

The chief mental processes. — When the brain acts in a certain way, experience results. The brain is the instrument, or organ, of experience. Mind, consciousness, is experience itself. The brain is the candle: mind is the flame.

There are many names for various phases, aspects, parts, of experience, and it will be well to note two or three of them now. The general process of gathering experience through the sense organs is called *perception*. *A perception is a mental picture of an object present to the senses.* You perceive the book you hold, for you are getting experience from it through your hands, which touch it, and your eyes, which see it.

Stored experience takes the form of *ideas*. An idea is a mental picture of an object not present to the senses. Close your eyes, put down your book, and form a mental picture of it. This picture is an idea. So also is your mental picture of a fairy, which you have never perceived.

When stored experience is reproduced, the brain remembers. A *memory* is an experience recognized as reproduced. What were you doing yesterday at this time? Studying psychology, perhaps. But you recognize that experience as old: there is no danger of confusing it with to-day's study.

The feelings. — So far, we have spoken of the mind as if its whole work consisted in picturing the environment and guiding us safely about. And no doubt its chief and original business was to hold the mirror up to nature in this way. But mind includes some very important processes which we have purposely neglected so far, namely, our feelings, emotions, moods, and sentiments. Happiness, joy, grief, anger, "the blues," envy, love, patriotism — this sort of experience is the mainspring of life: it makes us act. And it does not come to us directly from the environment, but is peculiarly our own. However, we shall find that perceptions and ideas lead; feeling follows. Later, we shall study feeling carefully.

CLASS EXPERIMENTS

The purpose of these experiments is to find how our minds work on certain problems.

1. Let the instructor give a phrase or sentence, such as, "'Tis the last rose of summer, left blooming alone." Each may write a description of the pictures which this calls into his mind. Comparison and discussion.

2. The instructor may give a word, such as ball, note, fire. Each will write this word and follow it with any ten other words that come to mind. Try to explain why each suggests the following. Compare the various lines of suggestion that stream from the common first word. Do they tell anything of the past lives of those who take part?

FOR FURTHER STUDY

1. Can an artist paint a mind?

2. When one has delirium tremens, does he see subjective or objective snakes? How do you know?

3. State some differences between brain and mind.

4. In the ghost exercise (Fig. 10), is there any object experienced when you see the face on the wall?

5. Since everything we ever mention has been experienced in some way, is there anything that cannot be studied in psychology? From what point of view?

6. Natural science deals with the world as it would be without human nature in it. Can we say that mental science deals with the world (or with mind) as it would be if "nature" did not exist? Why?

7. What is the difference between (*a*) seeing a train, from the outside, shooting through the landscape, and (*b*) being on that train? What is the difference between seeing some person in trouble, and being that person?

8. When you see a train, from the outside, how can you have any idea as to what is going on inside it? When you see some one in trouble, how can you have any idea as to what is going on in his mind?

9. (*a*) Why do you think your pencil has no mind? (*b*) How can you know a well-made wax figure from a human being? (*c*) How do you know your friends have minds?

10. Why do some joke and tease others, although they themselves get angry at once if such treatment is turned on them? Would you prescribe introspection for such cases? Explain.

11. Show that introspection is needed in order to interpret the golden rule.

12. There is an everlasting debate as to whether beauty is in the object or in the observer. Have you an opinion?

> "If she be not fair to me,
> What care I how fair she be?"

13. (*a*) Mind is a stream of experience that flows from stimulus to reaction. Give several illustrations, describing the stimulus, the experience, and the reaction. (*b*) Does not every act of ours become a new stimulus?

14. Is a mental picture like a photograph? (Remember that there are touch pictures, taste pictures, auditory pictures, and so on, as well as visual pictures.)

15. Has a rose any smell if inclosed in a glass jar? Has sugar in the bowl any taste?

16. Has a rose any color in the dark? (Do not answer unless you have studied physics.)

17. (*a*) You look at a lemon and say, "The lemon is yellow." (*b*) You eat a lemon and say, "I am sick." Why not say in (*a*) "I am yellow"? or in (*b*), "The lemon is sick"? ("Beware of wandering words.")

18. Suppose a child were brought up in two or three rooms and a few city blocks. What effect would this have on his development? ("The mental pictures the environmental.")

19. "That's all in your mind," we say, as we make light of some statement. Show the force of the argument.

20. Do again the exercises at the opening of this chapter.

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CHAPTER IV

MIND, NERVOUS SYSTEM, AND BEHAVIOR

Exercise. — Set down a number (perhaps fifty) "Samples of My Behavior." Include all sorts, heart beat and unconscious wink, habitual tooth-brushing, etc., up to deliberately determined, thoughtful behavior. Try to classify them into three groups according to the amount of consciousness that lies back of each: some behavior can go on without consciousness, other samples may be accompanied by a kind of half-consciousness, while still others are directed by full, concentrated attention. Do you find any that may be in two or more classes, according to circumstances?

A review of important facts. — We have seen that the muscular and nervous systems are partners in the great work of adapting us to our surroundings. They are constantly saving our lives or sacrificing them; for life itself is just a matter of give-and-take between body and environment. We have observed how the nervous system does its duty by:

1. Transmitting "messages."
2. Coördinating and unifying all parts of the body.
3. Storing experience and keeping it on record for daily use. It is the nervous system which enables us so to act that each to-morrow "finds us farther than to-day." There is no such daily progress in the life of a sponge.

Further, we found that experience, mind, consists largely of "pictures" of the environment. By preserving these subjective pictures and putting them in place of the objective things they stand for, we are enabled to act on things absent as though they were present, and on things-

to-come as though they were already here. So the better-brained man "foreseeth the evil, and hideth himself; but the simple pass on, and are punished."

The next object. — What you want to find now is, how the adaptive systems do the adapting, how mind and muscle work together to keep you afloat on the energy waves by which you are surrounded. These waves, you recall, are constantly beating in on you in the form of bumps and vibrations, *stimuli*. To some of these stimuli, the neuro-muscular mechanism reacts without your knowing it, as when a bright light makes the pupil of the eye grow smaller. In other cases, your thoughts and feelings, that is, *you*, are the conscious link that connects stimulus and reaction. This gives the two kinds of control, automatic and conscious, previously noticed. Now, why should some of your behavior be like protruding peaks, constantly lighted up by the glow of consciousness, while so much of it is left submerged? What behavior must or should be conscious, what automatic? And what difference do these facts make to the teacher? You can best answer these questions by looking again at the mechanism of adaptation — especially the nervous machine.

It is interesting to note that man can build machines that show wonderful power of adaptation, being self-oiling, etc. One scientist has even constructed an "electric dog" that follows a light to right or left, according to the varying position of the light. As a certain physiologist remarks: "If we could build an automobile which, knowing when it needed gasoline, would steer itself round to the garage and take in a supply, we should have something like human adaptation."

Improvements over the jellyfish. — Nature has invented many improvements since she made the jellyfish. The awkwardness of getting along without a brain, we have already noted. And we have seen that if an animal is to fit its ways to its environment, it must have sense organs, receivers, receptors,[1] delicate enough to catch all-important news from that environment.

But further, *we must have every sensitive spot, such as the eye or the ear, connected with every muscle.* Suppose that, as you start across the street, you hear something like the toot of an automobile. The thrill of that toot goes to your centers of hearing, located not far inside the brain from the ear. But if this center were not connected with the muscles of the neck or body, you could not aim your eyes in the direction of the sound to see whether you were in danger. Further, even if you did so use your eyes and saw danger close at hand, it would avail you nothing unless your sight centers were connected with your running muscles. If you are yourself driving a car, you must be able to call into commission also your arms and hands. The touches of the brake lever and other levers on feet and hands must in turn start nerve impulses that reach many widely-scattered muscles. A little reflection of this kind is sufficient to convince you that every sensory point of the body must be connected with every motor point.

Now, the jellyfish has its sensory and motor points connected in a rough, rambling way; but there is no close,

[1] The term *receptor* is coming into common use. It is a little broader than *sense organ*, for various reasons, one being that the sense organ is supposed to report to consciousness, while the receptor may receive stimuli without our knowing it.

direct, immediate connection. This switchboard connection nature secures for us by means of (1) neurones, (2) synapses, and (3) nervous levels. We must study these new features.

Neurones. — A neurone (from the Greek *neuron*, nerve) is a nerve cell, including its branches. A glance at the figure (Fig. 12) shows that its essential parts are the cell

1 2

FIG. 12. — 1, a typical neurone. 2, a section through the brain cortex, greatly magnified.

body (*c*), branchlets called dendrites (*d*) (from the Greek *dendron*, a tree), and an axone (*a*) (from the Greek *axon*, axis). The axone is a bundle of fine nerve fibers. When

it is inclosed in its usual white covering, the *medulla*, it forms what is known as a "nerve," commonly much the longest part of the neurone, and much branched. Neurones vary much in size and shape to fit different purposes. Some are less than a twentieth of an inch in length, others several feet.

Our nervous system is made of neurones. The spinal cord is a rope of them, about the size of an ordinary lead pencil; the brain is a clump of them. The spinal cord looks white because the white, medullated nerves are outside; the gray cell bodies are within. But in the brain, the gray cell bodies[1] are outside, the white nerves within.

In the whole nervous system, there are probably thousands of millions of neurones — no one knows just how many. Thorndike says that "even if we knew the exact arrangement of each neurone in a man's brain it would take a model as large as St. Paul's Cathedral to make them visible to the naked eye, a model with whose details only years of study would familiarize us." [2] Ebbinghaus suggests that "a man's life devoted to nothing but counting them would be too short to accomplish this task." [3]

Nerve currents. — A current, or impulse, passes from end to end of a neurone, much as an electric current passes over a wire, but very slowly as compared with nature's more rapid messengers. If it were one hundred feet from hand to brain, then a pin prick in the hand would be ex-

[1] Gray matter is not the seat of intellectual ability, as was formerly supposed. The cell bodies do not contain ideas, but appear to serve chiefly, if not wholly, as the stomach of the neurone, that is, they nourish it.

[2] Edward L. Thorndike, *Elements of Psychology* (2d ed.), p. 151.

[3] *Psychology* (Meyer's translation), p. 30.

perienced about one second after it had objectively occurred; and within the brain, where our thinking goes on, impulses travel not more than one tenth as fast as they do in the nerves outside. In the same length of time (one second), sound travels 1100 feet, and light or electricity would course seven or eight times round the world.

Mosso humorously suggests that if the Statue of Liberty were miraculously brought to life, she would make a very slow American, too slow to serve as guardian of the port of New York. She is 138 feet in height. If, then, any one touched her foot, he would have to wait about four seconds before she would give any sign of sensation and begin to move.[1]

To secure ideal nicety of connection, these nerve impulses must be carried over three courses: (1) from receptor to central office, that is, to the "central nervous system," composed of brain and spinal cord; (2) from point to point within the central nervous system, making connections as the telephone operator does at "central"; (3) from central out to the muscle or muscles that are to act. There are neurones for each purpose: (1) sensory, or afferent (*ad*, to + *fero*, carry) neurones, (2) connecting neurones (sometimes called association neurones), and (3) efferent (*ex* + *fero*) neurones. When you "see a pin and pick it up," an impulse (1) follows the afferent neurone from the eye to the back lobe of the brain, (2) from the back lobe to the front lobe of the brain, and (3) from the front lobe to the picking-up muscles. Currents are running, somewhere in the neurones, whenever you think, or feel, or perform any act.

[1] A. Mosso, *Fatigue* (English ed. of 1904), p. 75.

If these currents are interfered with, you are undone. If the afferent currents from eyes to brain are broken, you cease to see. If certain connecting currents are stopped, you may see old, familiar words on the page, but be totally unable to find any meaning in them. The South American Indian tips his arrows with curare, a poison which cuts off the efferent currents and so prevents the wounded animal from moving. This poison kills, as does that of infantile paralysis, by interfering with the breathing center. Motor currents no longer reach the breathing muscles, and death results from suffocation.

So far as the neurones are concerned, the nervous impulse might run at random all over the system. In fact, it would; for as water flows from a high-pressure to a low-pressure pipe, as heat spreads to cool places, as electricity flows from high to low "potential," so a nerve current runs where resistance is least. In the jellyfish, the nerve current does spread in this wandering way. It is the synapses that save us from being like the jellyfish in this respect.

The synapses. — Synapsis means "a fitting together." A synapsis is a point where neurones come close enough together to permit a current to pass. So far as we can find, the fibers do not touch, but are separated so slightly that a current can jump across from one neurone to the next, provided it is going in the right direction, the sensory-to-motor direction. (See Fig. 13.) No current ever flows backward, from efferent to afferent: the synapsis forbids it. If the current could be so reversed, then it is quite possible that if we, blindfold, picked up a pin, our visual centers would be so stimulated that we should have the experience of seeing a pin; going through the motions of

making music would cause us to hear music, etc. The subjective and objective worlds would be hopelessly mixed.

But further, some synapses are harder to pass than others. Much of this goes back to birth and before: it is hard by inheritance to do some things, irresistibly easy to do others. But throughout life, *repetition reduces resistance*, and more or less as more or less energy passes through the synapses. What you do most often and most vigorously, you will do again most easily. So, partly by nature, partly by nurture, we come to possess a nervous system that is a perfect labyrinth of graded resistances and preferred paths.

FIG. 13. — A sensori-motor arc, showing a synapsis in the spinal cord.

We can get some idea of what our condition would be if these graded resistances were broken down, by breaking them down with strychnine in the frog. Even to mild stimuli, it reacts with a convulsion that seems to involve every muscle of its body. There are no longer any preferred paths: all are wide open. The nervous system of an hysterical patient is in much the same condition.

But it is not enough to have one well-worn path from any sense organ to the muscle to be stimulated. There must be different paths to be used on different occasions, by which to arouse different movements to meet different situations. A certain stimulus, perhaps the prick of a pin, requires the action, now of a single muscle, now of a whole group of them.

"New occasions teach new duties." This is provided for by different levels of authority and responsibility, so to speak, among the neurones.

Possible paths of a nerve current. — Figure 14 shows, in an extremely simplified way, the possible paths of a nervous impulse through the central nervous system, as it is guided by the graded resistances of the synapses. The upper half of the circle represents the high-level; the lower half, the middle-level; the extension below, the spinal, or low level. S_1 and S_2 are stimuli, entering at the levels indicated. $M_1 \cdots M_5$ are possible movements. S_1 may be a mosquito drilling into your hand as you sit in church. If you are intent on the sermon, you may unconsciously withdraw the hand (M_1), or even rub it with the other (M_2). But there may be such a thrill started that it runs up to mid-level; and perhaps you see the insect (S_2). This may directly (instinctively, as we say) set off the slapping movements (M_3, M_4, M_5); or high-level may be called into play: you may reflect

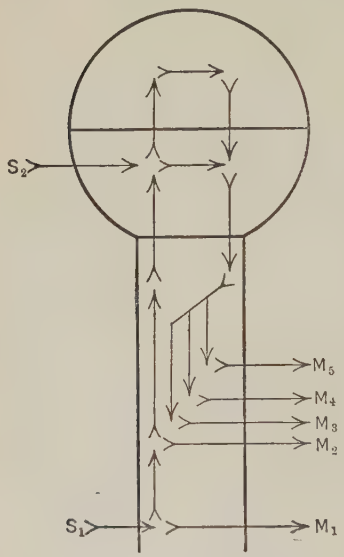

FIG. 14. — To show possible paths of a nervous impulse through the central nervous system. Suggested by diagrams presented by Ebbinghaus (*Psychology*, Meyer's translation, pp. 36, 37), by Miller (*Psychology of Thinking*, p. 25), and by Thorndike (*Elements of Psychology*, 2d ed., p. 150).

that church is no place for such executions; or you may determine to take public vengeance at all costs, and deliberately set off M_3. . . M_5.[1]

Levels of the nervous system. — Perhaps we can best understand man's nervous system by comparing it with that of the lower animals. For the earthly habitat of the soul of man there have been built more stately mansions of neurones, vaster domes, arches, and loops of nerve fiber.

Three levels have been distinguished. The low, or spinal level, is somewhat like that found in animals which have no eyes or ears, or anything more than a little knob of nerve cells to serve as a brain. The earthworm offers a familiar example of such a system.

The second level, the mid-level, is somewhat like the upper story of the nervous system of animals which have special sense organs in the head, and a real brain — the dog, for example. Compare his experience and coördination of movement with those of the earthworm and you will see what our mid-level neurones enable us to do. The higher we go in the nervous system, the greater the responsibility and authority, each higher center stimulating and controlling a number of lower centers, and through them, their many muscles. But while such a two-level system may gather and store experience, it does little in the way of analyzing it, or building up new and original ideas.

Man has an elaborate three-level nervous system, characterized by great increase in the size of the cerebrum, the front and upper part of the brain. Of course, nervous sys-

[1] A discharge from a higher center ordinarily involves many lower ones, as indicated, but need not always do so.

tems are not separated into levels by sharp dividing lines, as houses are divided into stories. There is no way of knowing, as yet, exactly where one level leaves off and another begins. Some would call the nervous system of the dog a three-level system. But for our practical purpose, the ability to *think* seems to be a good test of the presence of the highest level.

Man's brain has more and longer connecting neurones than any other, great loops and arches of them built above the second level. Here lies the secret of his imagination, his seeking out of witty inventions, and his minutely adapted behavior. A single idea, lodged in these high-level neurones, may control all lower centers, and so all behavior, for years, or for life. The ideal of youth is realized in maturity.

Where is consciousness? — We have already found that mind dwells in the brain. Just why it should not have its home in the synapses of the spinal cord also, or exactly what happens in the neurones when consciousness takes place, we do not know. But, as James says, consciousness deserts all processes where it is no longer of use. To look at the same truth from the other side, consciousness goes where it is of most use; and that is where new adaptations are being worked out. The mind behaves like a good general, who leaves the lesser routine affairs to be discharged by subordinates in forms fixed by long practice, while he devotes himself to the perilous new which must be met by an ever varying plan of campaign.

In view of this, we should not expect the spinal cord to be conscious, for its duty consists in running off old acts of behavior mechanically, not in devising new acts variably.

It is the business of consciousness to make new adjustments, but the lower nerve centers have no such adjustments to make.

It is even thinkable that, if all seasons were alike and all environment changeless, mind as we now know it would die out.

It is the old man, whose failing nervous system has dimmed and subdued his mental powers somewhat, who becomes the extreme conservative, who is satisfied to "let well enough alone," and who wishes nothing better than to see things preserved "just as they used to be."

Monotony kills consciousness. We do not sense the pressure of the air, fourteen pounds per square inch of our skins, because we are "used to it." The Esquimau,

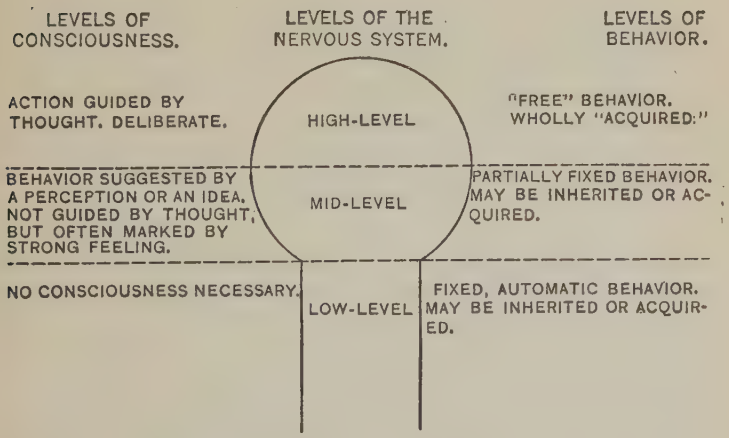
LEVELS OF CONSCIOUSNESS.
LEVELS OF THE NERVOUS SYSTEM.
LEVELS OF BEHAVIOR.
ACTION GUIDED BY THOUGHT. DELIBERATE.
HIGH-LEVEL
"FREE" BEHAVIOR. WHOLLY "ACQUIRED."
BEHAVIOR SUGGESTED BY A PERCEPTION OR AN IDEA. NOT GUIDED BY THOUGHT, BUT OFTEN MARKED BY STRONG FEELING.
MID-LEVEL
PARTIALLY FIXED BEHAVIOR. MAY BE INHERITED OR ACQUIRED.
NO CONSCIOUSNESS NECESSARY.
LOW-LEVEL
FIXED, AUTOMATIC BEHAVIOR. MAY BE INHERITED OR ACQUIRED.

FIG. 15.—Showing relations of mind, nervous system, and behavior.

living in constant cold, the African in constant heat, have accomplished less than those from whom nature has demanded more variety of adaptation. Consider the longing of the growing child mind for perceptual variety. As adults, many must still depend on this dance of perceptions to keep them "alive"; others, a more limited number, find their variety by working out new thought-combinations.

Levels of behavior. — Figure 15 will help to systematize much of what has gone before.

The circle represents the brain; and the portion below the circle, the spinal cord (including the medulla oblongata). Obviously, there are no such sharp dividing lines in the nervous system. Following are examples of the various kinds of behavior mentioned:

High level: Thoughtfully investing money.
Mid-level: Acquired (Habit): Habitual gum chewing or candy eating.
Inherited (Instinct): Fighting because angry.
Low-level: Acquired: Running bicycle pedals after long practice.
Inherited: Beating of heart.

How nerve impulses influence each other. — Nerve impulses, like interflowing streams of water, may help or hinder each other. The helping is called *facilitation;* and the hindering, *inhibition.*

Facilitation may take place as you sit reading, if some one behind you tickles your cheek. The first tickle may bring no response; but the nervous impulse aroused seems to make the neurone more sensitive to succeeding stimuli.

As the tickling continues, there is a " summation," reënforcement, combining of stimuli. The result may be action, perhaps conscious action, though any of the tickles, taken alone, would not have produced it. Stimuli may facilitate each other under a variety of conditions. In case of the mosquito in church, the two stimuli, the drilling into your hand, and the sight of the little insect robber, are likely to facilitate each other, hasten your reaction, and make it more energetic. Or a young man, about to carry the ball forward in a football rush, may find his nerve currents facilitated by a glimpse of a friend, followed by the cheers of the crowd.

Inhibition is illustrated by the case of a swimmer whose cramps inhibit his swimming. Here, consciousness does not control; but our lives are full of experiences where it does.

Both facilitation and inhibition may be studied by introspection. Many times a day one idea is knocked out, inhibited, prevented from expressing itself, by an opposing idea. You think of doing something bold, bad, rash, but your incipient wickedness is quickly strangled by the succeeding thought of what " they " would say, or of your mother, or of God.[1]

What meaning has all this for education? — Much every way. To educate a child is to make such paths and set up such currents in his nervous system that he will react more successfully and adapt himself better to the world

[1] Some like to have an inhibitory reminder, such as a ring, a photograph, or a crucifix always about. To many, God is the Great Inhibitor. Milton lived as ever in his Great Taskmaster's eye. The Ten Commandments are a table of *nots*, inhibitions.

he lives in. Now, we find some nervous paths fixed at birth, beyond our changing; and many others are fixed all but the finishing touches. There is no highway department that can plan and put through thoroughfares at pleasure in the brain of a child. But often there are rival paths with equal reënforcement. Here the teacher holds the balance of power between good and bad.

And further, luckily for us, the supreme level of the nervous system is the most plastic part. Each upper nerve center controls many lower ones. The teacher's responsibility for enthroning ideals in these higher neurones should make him purify himself for his pupil's sake. For every item of experience does its bit in building this maze of graded resistances and preferred paths. Whatever goes in as consciousness comes out, some time, as behavior. No one, pupil or teacher, can eat an olive or utter a prayer and be quite the same afterward as before. In one sense, your pupil will be the sum of the experience you give him and the behavior you put him through. His nervous system, as you form and build it, will be a minute map of his character. An omnipotent physiologist could probably examine his neurones and from them read off the record of his past and predict much of his future. "See the world?" says Henry van Dyke. "Yes, see the world; but remember that you become most like what you look at longest."

CLASS EXPERIMENTS

1. *The purpose of this exercise is to study how, in the repeated performance of a simple act, we pass from full consciousness of it to partial consciousness, and so toward automatic performance.*

When the instructor directs (but not before), study Fig. 16. Then try to see if, with eyes closed, you can form a mental picture of its

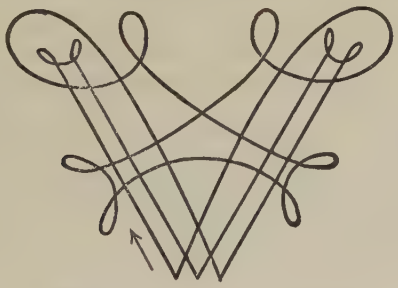

FIG. 16. — A study in learning.

general plan. Next, copy it, starting at the arrow. Do not erase or correct: if you go wrong, number the unsuccessful drawing and start another. How many trials are necessary before you can make it without seeing the pattern? How many before you can repeat, while drawing it, "Mary had a little lamb"?

Introspection of interesting points may be given.

The instructor may use other figures.

2. A study of inhibition.

Play a variation of the game, "My aunt has arrived from India," in which each must pretend to use, and keep using, whatever his aunt has brought him. The instructor may announce the gifts, as: "A pair of slippers" (feet are kept patting the floor). "A fan" (left hand kept waving). "A music box" (right hand turns crank). "A pair of glasses" (eyes wink regularly). Etc.

Introspection and study of how movements tend to interfere with, that is, inhibit, each other.

FOR FURTHER STUDY

1. Give some samples of stored experience that you have made use of to-day.

2. Give instances in which "you" are "the conscious link that connects stimulus and reaction."

3. What is accomplished by having some of our behavior "lighted up by the glow of consciousness, while so much of it is left submerged"?

4. Show why it is necessary to have every sense organ connected with every muscle. What would happen if this were not so?

5. Trace some resemblances between a telephone system and a system of neurones.

6. When the blood supply of a limb is interfered with in a certain way, the limb "goes to sleep" because the nerve is poorly nourished. Describe the experience, and the behavior of the limb. What does this show?

7. Give instances to show that repetition reduces resistance in the performance of an act.

8. Why can we not educate dogs as easily as we can children? (Compare their brain levels.)

9. I attempt to swat a fly: as soon as the swatter begins to descend, I see the fly make off, yet cannot stop my stroke. Explain this in terms of nervous impulses.

10. Is it better to cheer an athlete when he is about to make a difficult play, or to have perfect silence? Why? Compare a football rush with the throwing of a foul in basket ball.

11. Would it be well to have a group of admirers stand by and cheer for a surgeon when he is about to make a critical stroke with the knife? Why? (Compare *amount* of nerve energy with delicate *control*.)

12. One rule of croquet provides that a player shall not be spoken to while making a stroke. Why should this be?

13. Select a few cases in which you feel that your consciousness has been very high. Can you find any general characteristics of such times? In particular, was this full consciousness called out by new situations, or old?

14. "Monotony kills consciousness." Illustrate. Do you find any exceptions to the statement?

15. Give further examples of the kinds of behavior mentioned under "Levels of behavior."

16. Describe cases of inhibition.

17. A robber or a grafter may react "successfully" on his environment. Is he then well educated? Explain. Compare the length of various kinds of success.

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CHAPTER V

NERVOUS CHANNELS AND MENTAL CURRENTS

Exercises. — 1. Predict what each of the following words will make some friend of yours think of first; then try them on him, asking him to react by pronouncing the first word that enters his mind after you give the signal word. Bread. Boy. Day. Good. High. Humpty. Fast. True. Easy. Rich. Explain the results.

Do the same with these: Money. Note. Red. New York. Vote. Potato. Fox. Fish. Picture. Memory.

Did you succeed as well with the latter list? Explain further.

2. Turn to the discussion of attention in some other textbook and substitute the word *consciousness* for *attention* wherever the latter appears. Do the statements still make sense? How do you explain the result?

Problem of this chapter. — Let us recall that the nervous system is the chief adaptive system, the great controller of what we do. Its lowest level has no consciousness, and controls fixed behavior only; in its upper levels run the currents of our thoughts and feelings, and also the nervous impulses which set off all our behavior that is not mechanical. Although there are those who deny that a thought can cause an act, we naturally believe that the consciousness sets off the conduct — is the conductor, so to speak. "To-morrow," I think, "I will buy my new hat." The day comes. I buy the hat. And I should certainly not have bought it had not the thought preceded.

Now, if it is true that consciousness controls conduct, it is a very important truth for us teachers; for that which stands first in consciousness, which "gets our attention"

by its attractiveness or " gets on our nerves " by its odiousness, is likely to stand foremost in conduct. The fisherman finds that he can induce a fish to bite, even when it is not hungry, if he can dangle his bait before its eyes for a time. Let anything hold your attention for a protracted period, and it is almost impossible for you to do otherwise than act on it. As our thoughts and feelings follow each other and form connections, so our various acts are likely to get connected. Further, it is reasonable to suppose that corresponding connections are made among the synapses.

To know how to educate a child is to know how to put him through such experiences as will wear proper paths in his nervous system. Our problem, then, is *to learn what controls the wearing of paths and the forming of connections*. How can we make a hatchet suggest truth-telling, even more strongly than it does the cutting down of cherry trees?

We can discuss this problem more understandingly if we first glance at the structure of the brain and its way of working.

The brain. — The medulla oblongata (literally, oblong marrow), commonly called the medulla, or bulb, is the enlarged upper portion of the spinal cord, seen in the figure (Fig. 17) just back of the ear. It is not a seat of consciousness, but contains important automatic centers, such as those for breathing, heart-beat, swallowing, and regulating the movements of the stomach. The cerebellum (literally, little brain) likewise is not a center of consciousness, but an automatic center. It is thought to be a regulator of muscular movement.

The part of the brain in which we are most interested is the cerebrum, an organ so large that it fills nearly the whole of the upper part of the skull. The figure (Fig. 17) shows the left half. The right half, which is similar (as the right hand is to the left), is partially separated from its

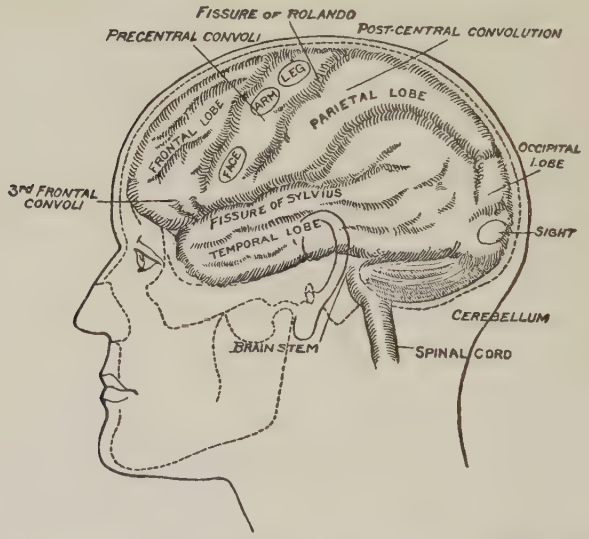

FIG. 17. — Showing the position of the brain, its main divisions, and some of its special centers.

mate by a deep fissure which runs from forehead to back-head. But a band composed of a multitude of fibers connects the two halves, and as each center (except one) on the left side has a corresponding center on the right, the two hemispheres, as they are called, work, for the most part, as a single organ. However, each half is connected

with the *opposite* half of the body. Should convulsive twitchings in the right arm indicate brain lesion, the surgeon would remove a button of bone so as to uncover the center marked " arm," in the left frontal lobe.

For convenience in referring to the brain, it is divided, in a rough way, into lobes. The upper front quarter of each hemisphere is the frontal lobe; the upper back quarter, the parietal lobe; the lower front quarter is the temporal lobe; the lower back quarter, the occipital lobe. With the exception of the fissure of Sylvius and the fissure of Rolando, there are no definite boundary lines in common use.

The work of the brain. — As we have learned, the brain is a great central office for the business of the nervous system; and it does its work in a businesslike way, having " a place for everything and everything in its place," a special department for each separate function. As we should expect, it has (1) receiving stations (sensory, afferent), (2) connecting fibers (often called association fibers), and (3) sending stations (motor, efferent).

The receiving stations are connected with the sense organs. The receiving station for the eye is in the occipital lobe; that for the ear, in the temporal lobe; and those for the skin and muscles, in the post-central convolution (see Fig. 17). The chief stations for sending messages to the muscles are in the pre-central convolution. The connecting fibers between stations are especially abundant in man's brain. As compared with the brain of a lower animal, these are what give it such great bulk, and constitute its chief point of difference.

If a center is injured, its work is interfered with. If

the center for sight is destroyed, we not only can not see, but can not even remember or imagine how things look. It seems safe to say, then, that whenever we are seeing, or picturing things seen, a nervous impulse is exciting the visual center. Laura Bridgman became blind and deaf when less than two years old. When her brain was examined after death, it was found that the centers for sight and hearing were underdeveloped, and contained a large number of undeveloped nerve cells.

As the mind passes from point to point, from moonlight to music, and thence to the cool swish of the water against the hand that overhangs the boat, or to the movements of the dance, the neurones in center after center are starting their mysterious processes all about the brain. If we could watch these conscious currents as they play hither and thither about the cerebrum, it would probably remind us of a restless fire whose flames flash and die and burn again from point to point incessantly. And the stronger and livelier the consciousness, the stronger and livelier the brain currents.

The problem of preferred paths. — Perhaps it would be more appropriate to speak of " wires " than of " paths "; for the nervous impulse runs along fibers which, for the most part, are insulated somewhat as electric wires are.

We have found that the brain is a perfect web of neurones. If we could map the preferred paths through this maze of fibers, it would make a map much more complex than any we have ever seen of a railroad or a telephone system. What causes these paths to form, and keeps them open? Why does money in pocket lead us to-day to give to charity

and to-morrow, to buy some luxury? On the answer hang all teaching and learning. Hereby do we explain all skill of hand, all cleverness of mind. If there is any one most important thing for teachers to know, it is just what follows now.

The chief factors that determine our nervous and mental connections are:

1. Brain set.
2. Mental set.
3. Intensity of current.
4. Frequency of passage of current.
5. Recency of passage of current.

We shall study these in order.

Brain set. — Brains all have, in general, about the same parts; but as flowers so often seem to specialize in producing a fine calyx, pistil, or corolla, their other parts being small or ill-formed, so the average brain fairly blooms out in certain centers, but is weak, perhaps blasted, in others. Every student can pick out born "fiends" for mathematics, science, language — and also born failures. One can sing, or play the piano well at five years of age; another can never mount the scale. If we could see all our brains thrown up in relief according to the inborn efficiency of their different centers, we should find them as varied as landscapes or faces are.

And further, this hereditary brain set is likely to be reënforced by years of experience. Your mathematics fiend is likely to practice mathematics by teaching or otherwise. In time, his brain becomes so sensitive to the subject that it has permanent right of way there: new

problems open new brain paths and are solved with marvelous ease.

By brain set, then, we mean an arrangement of neurones favorable to the forming of nervous and mental connections of a certain kind, an arrangement which is inborn, but modified (helped or hindered) by practice, by experience.

Mental set. — Brain set is *long-lived* and *not conscious* necessarily: it is a matter of arrangement of nervous machinery, and so is present in a sleeping brain, or even in a dead one. Mental set is *shorter-lived*, and requires *consciousness*. It is a temporary throwing open of the channels to a certain kind of thought or behavior, much as one may turn a number of railroad switches. You come from a French recitation into the psychology class and are at once asked a question. You know the answer but can not summon it immediately because your mind is " set " for French. Students who have passed from one foreign-language class to another have been known to reply in the wrong language.

Mental set can often be induced by suggestion and cir cumstance. A certain ticket seller states that when he is in his office, he can give immediately all details concerning the trains that pass through his station, but is quite unable to do so at home. Home starts a different mental set. At a Hallowe'en party, our minds are set by decorations and darkness for the seeing of ghosts. Talk of music for five minutes and the word " note " will call up one thing; talk of banking, or of classroom lectures, and it will suggest something quite different. The skillful teacher " prepares " the pupil's mind at the opening of a lesson by many

suggestions or questions that will induce a favorable set of mind.

Much depends, in every human situation, on inciting the right mental set. It makes a great difference whether we ask the people to prepare *for* war or prepare *against* war.

Dorothy Leonard's poem, "Two Views," published some time ago in the *New York Times*, shows how each sees what his mental set (and perhaps brain set) causes him to see.

Oh, what do you find in my little green garden?
What did you find in my garden so gay?
"Rosebugs and slugs and fat caterpillars,
Little green worms and the rose-leaves half eaten,
Mildew and blight and a smell of decay."

Oh, what did *you* see in my poor little garden?
What did *you* see in my garden so dreary?
"I saw a bird like a jewel go flashing,
Peonies blowing and purple flags flowing,
Saw the sun set, heard the harp of the veery."

Mental set, then, is a conscious, temporary tendency to open brain paths of a certain kind. It is probably accompanied by the charging of certain parts of the brain with more than the usual amount of nerve energy.

Intensity. — The wearing of brain paths is suggestive of the wearing of water ways. Where water goes depends on the "lay of the land." Where a brain current runs depends on the set of the brain. Further, if a deluge sends a flood current of water through a given channel, it is likely to be so deeply fixed that it will hold its own against all rivals for a long time. So, if a strong stimulus sends an

intense impulse over a chain of neurones, the resulting channel may remain fixed for life.

Throw out the word " fire " to start associations in a group of people, and somebody usually thinks of a fire which, years ago, gave him an intense experience. The brain path is so fixed that he tells you he " can never forget." So the naturalist who ran into the cactus bush never forgot his lesson. It is for intensity that we use emphasis in speaking, underscoring in writing, italics in print, red chalk for misspelled words, etc. It is largely for intensity that we use objects and apparatus in school. Objects start stronger nerve currents, usually, than do words or ideas.

Frequency. — *Repetitio mater studiorum*, " Repetition is the mother of learning," was long the teacher's motto. Resistance at the synapses seems to be reduced in proportion to the amount of nervous energy that passes through. As most of our nervous currents are of moderate intensity, we must depend on abundant repetition to fix many of our brain paths. " Practice makes perfect." So " bread and butter," " boy and girl," " day and night," are so often repeated that one member of a pair almost invariably calls up the other.

Recency. — Brain channels seem, like water channels, to become clogged if unused. And besides, new paths sometimes tend to obliterate old ones. In this respect, the brain is like a blackboard many times written over without erasing. Other things being equal, the most recent writing stands out. So, musician and orator want a recent rehearsal, no matter how old the performance; the student reviews his lesson on the way to class; the

teacher is astonished at the meager results on examination day if he has not held a recent review.

These five laws, brain set, mental set, intensity, frequency, recency, are the five fingers that make strong the teacher's grasp on his pupil's mind and behavior. Some psychologists would add the law of *primacy* also: the *first* time anything is experienced, the nerve cells are fresh and impressionable and pleasure or displeasure often intense. But intensity is included in the laws already given. Judge for yourself whether primacy is sufficiently important to be made a sixth law.

We shall find that these laws apply to every mental process, be it memory, thought, or emotion, and to the learning of every skillful act, such as writing. How can it be otherwise, since all experience and behavior depend on nervous paths, and these are the laws by which nervous paths are formed?

Attention. — As attention is supposed to determine what stands out in our minds, and so what gets itself expressed in our behavior, it must be closely related to the five laws just discussed.

The word " attention " is much misused, and does not mean any one thing consistently and all the time. We often speak of it as if it were a kind of mysterious force-in-itself, capable of doing what it pleases; but it is not. You probably feel that you can pay attention to what you please. And so, in a sense, you can. Yet you are just as much subject to stimuli, including brain currents, which themselves stimulate other centers, as an automobile is to its steering wheel. But it may take years to convince you of this.

Attention is simply direction and force of consciousness.

We shall probably get a truthful picture of the facts if we think of an interplay of neuro-mental currents (that is, nervous currents accompanied by consciousness) somewhat like the interplay of a number of streams of water of varying size and force. Currents from some stimuli are inhibited: they are too weak to make much difference with the general direction of the stream. You pay little heed to the piano in the distance if your mind is flowing, full force, toward your lesson. The soldier in battle often does not know he is wounded and bleeding, till the charge is over, or he grows faint. Here we can see why a great and good purpose is the best inhibitor of all stimuli to do evil.

As a stream flows with stronger current at the center and more lazily along the sides, so consciousness has an intense "center" and weaker side currents. One object, perhaps your friend as he approaches, is central in consciousness, takes your attention, while the whole expanse of landscape about him comes but dimly to mind. The "field" of attention (to use a different figure) is often likened to the field of vision: make any one object prominent and clear, and all others recede and grow dim, some to the point of disappearance.

Kinds of attention. — Many names have been invented for different kinds of attention distinguished by various psychologists; but we shall probably keep closest to the truth of the matter if we recognize but two main kinds, *naïve* and *reflective*.

Naïve means natural, childishly natural, natural in the sense of untaught, undisciplined, unorganized, unreflective.

We can see this naïve attention (flow of consciousness) at its purest in the lower animals and young children, for they are capable of no other kind. In such cases, the high-level nervous centers are either not present or not active, and consciousness is likely to flit from object to object as one lower center after another is stimulated by the outside world. The playing child gives us the typical picture as he attends successively to the bark of the dog, the flitting of the butterfly, the smell of a flower, the tickle of the fly crossing his hand. But, as the child's mind wanders from perception to perception, so the adult attention may go haphazard from idea to idea, as every daydream shows. Naïve attention is, for the most part, thoughtless attention, attention not guided by any clear purpose. Its interest does not, as a rule, reach beyond the passing moment.

Rival perceptions or ideas often give rise to curious mental conflicts. When you find a friend undergoing such a conflict, it is amusing (if no harm can result) to start " currents " on one side or the other by offering suggestions. Children can be induced to reverse themselves two or three times in succession. It is a part of the art of salesmanship to watch the customer and really decide for him which of two articles he will take, by deftly retiring one of them and " talking up " the other.

Reflective attention, on the other hand, is guided by clear purpose; and it is usually long-span attention, determined by something far in the future. A good example of it is the student who, though lured by theater, dance, and the gay life generally, keeps his mind on graduation years ahead and faithfully turns to and does his daily task. And whereas naïve attention follows a feeling of

some kind, reflective attention, like high-level behavior, is " guided by thought."

Here also, as we find so often in psychology when we try to make sharp distinctions, we can fix no very definite dividing line. When a horse works his halter off and finds his way to the feed box, or a dog watches unweariedly at a woodchuck hole for hours, there seems to be long-span effort for an object which may stand out fairly clear in the animal's mind.

In our own lives and in the lives of our pupils, the struggle is ever to replace naïve with reflective attention. In lower grades, we try to make every exercise so attractive that there is no temptation for naïve attention to wander; but in the higher grades, we should train the pupil's mind to stick to the bitter end, no matter how bitter it may be.

In time, reflective attention comes to need a thoughtful *start* only, after which it runs on as a habit for a considerable stretch.

High and low consciousness. — Since attention includes both *direction* and *force* of consciousness, one further factor must be considered: the mental stream may be high or low.

When you are in fine fettle mentally and feel equal to any task, consciousness and nervous energy are abundant, and you can easily " pay attention," that is, give lively consciousness, to almost anything. But when sleep weighs heavily on you, the stream of consciousness is reduced to a vagrant trickle. Lessons remain irresistibly hard, however often repeated. Everything gets hazy. All is vanity save the enticing bed. You feel that you are not " all there " — and you are right. Attention is low.

To be strictly accurate, then, we should speak, not merely of naïve and reflective attention, but of low or high naïve attention and low or high reflective attention.

Diffused and concentrated attention. — The amount of mental energy we can exert at any time is limited, like the amount of physical energy. We may expend it all on a single object, or scatter it on many. Which we do should depend on our purpose. If we want water to irrigate a wide expanse, we spread it out thin; but to turn mill wheels we concentrate it in one powerful stream. The teacher, standing before a class, must often give diffused attention to the whole room; the student, alone with his lesson, should concentrate.

In life at large, the diffusion policy irrigates the mind into variety and luxuriance of ideas, interesting as an unexplored jungle. Such diffusion is permissible in youth, when one may well be a jack of all things until the mind comes to itself; but the majority of men feel, as they mature, that the age requires of them the concentration of the specialist. The most common demand is for high, concentrated, reflective attention.

. . . . . .

You have now taken a first general view of all that you will find in psychology, much as you take a first general view of a school before cultivating the acquaintance of the individual classrooms. In Part Two, we shall study such details of mind as are most necessary for the teacher to know.

CLASS EXPERIMENT

The purpose of the exercise is to get some indication as to which laws control most of our everyday associations.

Let the instructor pronounce the following hundred words [1] to the class at the rate of about four per minute. As each word is pronounced, the student will write it, and following, whatever the word first suggests to him.

Table	Sweet	High	Memory	Butter
Dark	Whistle	Working	Sheep	Doctor
Music	Woman	Sour	Bath	Loud
Sickness	Cold	Earth	Cottage	Thief
Man	Slow	Trouble	Swift	Lion
Deep	Wish	Soldier	Blue	Joy
Soft	River	Cabbage	Hungry	Bed
Eating	White	Hard	Priest	Heavy
Mountain	Beautiful	Eagle	Ocean	Tobacco
House	Window	Stomach	Head	Baby
Black	Rough	Stem	Stove	Moon
Mutton	Citizen	Lamp	Long	Scissors
Comfort	Foot	Dream	Religion	Quiet
Hand	Spider	Yellow	Whisky	Green
Short	Needle	Bread	Child	Salt
Fruit	Red	Justice	Bitter	Street
Butterfly	Sleep	Boy	Hammer	King
Smooth	Anger	Light	Thirsty	Cheese
Command	Carpet	Health	City	Blossom
Chair	Girl	Bible	Square	Afraid

Let each go through his list and indicate, as best he can, to what each association was due, whether brain set, mental set, intensity, frequency, or recency. *B* may be used for brain set, *M* for mental set, and so on. Cross out all cases where there is serious doubt as to explanation.

[1] Taken, by permission, from the *Psychological Review*, Jan., 1913, p. 54.

One member may compute for the class the per cent of associations due to each law. Doubtful cases are to be omitted.

Criticize the experiment. Is it as good a test for brain set as Exercise 2 below?

FOR FURTHER STUDY

1. Practice drawing Fig. 17 until you can make from memory a fair outline sketch of the brain, showing its principal features.

2. Ask some one to write rapidly the first hundred words he can think of. Examine the list and try to tell something of his past life, occupation, chief interests, and so forth.

3. "I'll make you remember this!" What law do we probably expect to make use of when we threaten thus?

4. A boy, blind from birth, knew a cat by touch. On receiving his sight, he could not recognize the cat without touching her. At length he picked her up, stroked her, and at the same time looked at her intently, saying, "Now, puss, I shall know you next time." Explain in terms of connecting currents.

5. "Why does money in pocket lead us to-day to give to charity and to-morrow to buy some luxury?"

6. Give instances of your own to illustrate brain set, mental set, etc.

7. If brain set is so strongly fixed by heredity, what influence should this have on school work?

8. A good canvasser rarely cares to sell more than one line of goods. Why is this? Do people buy chiefly what they want, or what is sold to them?

9. Why do some of your old enthusiasms excite you so little now? Ten years from now, how do you think you will regard your present self?

10. Observe how much closer you can get to a fly if he is feeding than you can if he is merely resting. Why is this?

11. Can one be conscious and not be attentive to anything?

12. Collect many expressions containing the word "attention." Can you harmonize them all with the explanation of attention given in this chapter?

13. Introspect the difference in mental set as you (1) eat lunch with friends, (2) sit in the dentist's chair, (3) go before an audience.

14. Give your own examples of the kinds of attention.

15. How should you get the attention of a doctor? a miner? a lawyer? a young lady? an active boy? a baby? (Apply the laws of brain set, mental set, etc.)

16. Collect instances of your attention. Do you need anything more than the five laws given in this chapter to explain them?

17. How can you start a topic of conversation that will " draw out " every one present? How can a politician find an issue that will interest and " catch " the majority of the voters?

18. " I can see the pink sunbonnet
And the little checkered dress
She wore when first I kissed her," etc.
Do you think the law of primacy is necessary to explain this? Why?

19. Hunger will tame a lion. Why?

20. Get several friends to tell you what word in the language means most to each of them. What do you find as to revelation of character in the result?

21. Interrupt a busy friend and ask him quickly whether he would say " Six and seven *is* eleven," or " Six and seven *are* eleven." Explain the result.

22. The " psychological moment " for doing a thing (such as asking another for something you want) is the most favorable moment mentally. Explain and illustrate in terms of mental set.

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PART TWO

A MORE DETAILED STUDY OF MIND AND BEHAVIOR

CHAPTER VI

WHAT THE MIND IS MADE OF

Exercises. — 1. (*a*) Select any object, such as a book, an apple, or a pencil. Make a list of the items of knowledge of this object contributed by each sense organ. What "news" of it is furnished by the eye, the ear, skin, muscles, etc.?

(*b*) If you take away, one by one, all these items of news, what is left of your perception of the object? Suppose you had never seen, heard, etc.: what difference would it have made with your experience of this object? What difference would it have made with your mind as a whole?

(*c*) Of what are perceptions made?

2. Review pages 49–51.

Mind is made of experience. But of what is experience made? We have seen that the brain:

1. Gathers experience.
2. Records and reproduces experience.
3. Analyzes experience.
4. Synthesizes experience.
5. Expresses experience in conduct.

The great bulk of our experience is gathered in the form of perceptions and reproduced in the form of ideas. In this chapter, we shall analyze a few samples of experience, and study their parts.

The analysis of mind. — Analysis means "taking apart," especially, separating anything into its elements. Elements are simplest parts.

In everyday life, you seldom analyze things: you *use* them — salt on potatoes, water to drink. But if you want thoroughly to understand salt or water, you analyze it. The result is often surprising: water yields two gases, hydrogen and oxygen, neither of which seems like the liquid you swim in. So, if you hope ever to look understandingly into the soul of your pupil, you must analyze mind; and the result is usually surprising — somewhat like analyzing a picture into so many dabs of paint: the picture is gone. But psychology synthesizes, too: you will make more beautiful pictures than those you destroy.

You cannot pull your consciousness apart as you do a flower; for mind is made of *processes*, not things. To analyze it is much like separating the tongues of flame that enwreath each other in a dancing fire. Let us try the task.

Analysis of perception and idea. — You recall that a perception is a mental picture of anything as present; an idea is a similar picture of anything as absent — or at least, not seen, heard, touched, etc. Let us list the simple parts of your perception of an orange here in your hand, and your idea of one on a distant fruit stand.

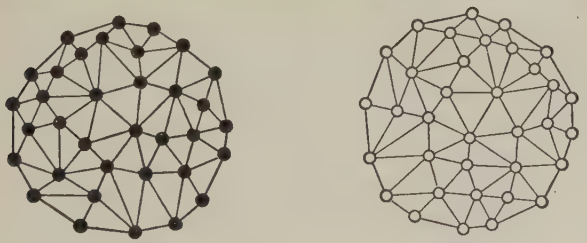
Perception	*Idea*
Color	Color
Form	Form
Size	Size
Touch	Touch
Taste	Taste
Etc.	Etc.

There is a striking similarity: the elements seem the same. In fact, there is but one difference between this perception and this idea: the perception is made of *impressions;* the idea is composed of *images.*

An impression is the simplest bit of experience as it comes to us by means of a sense organ. Examples are: the color red while the eye is fixed on it; the taste of sugar while it is on the tongue.

An image is a revived impression. That is, the brain revives the impression as best it can without having the sense organ stimulated again. Examples are: red as imagined, say with eyes closed; sweet as experienced without stimulating the nerve of taste.

Contrast of perception and idea. — A perception is a unified group of impressions — unified because all referring to the same object of experience. In Figure 18, *A* suggests



A

A. Perception.

B

B. Idea.

FIG. 18. — "Map" of a perception and of an idea.

a perception, each solid little circle standing for an impression. In *B*, the impressions are revived, resurrected in a pale, ghost-like form, as images. An idea is a unified group of images.

As impressions are usually more strong and stable than

images, so perceptions are usually more clear, strong, and stable than ideas. You would hardly mistake your idea of a dollar for the perception of the dollar itself. Yet such confusions do occur. In one case, a man, on meeting a friend in the street, was even unable to tell whether he was speaking to the real individual or to an idea of him, until he touched the friend or heard his footsteps. All that is necessary to produce such confusion is to excite that part of the brain, where these images are recorded, as vigorously as it usually is stimulated by the action of the sense organs.

So the lover, in Riley's *An Old Sweetheart of Mine*, says:

> "An old sweetheart of mine! — Is this
> her presence here with me,
> Or but a vain creation of
> a lover's memory?"

Images from childhood come back with almost the intensity they had originally as impressions. The climax of the poem is the substitution of a sure-enough perception for what turned out to have been a mere idea:

> "But, ah! my dream is broken
> by a step upon the stair,
> And the door is softly opened,
> and — my wife is standing there:
> Yet with eagerness and rapture
> all my visions I resign, —
> To greet the *living* presence
> of that old sweetheart of mine."[1]

[1] From "An Old Sweetheart of Mine," by James Whitcomb Riley. Used by special arrangement with The Bobbs-Merrill Company, publishers.

Ideas can vary more than perceptions. — Those who wish to see the world, travel all over it in search of new perceptions. Yet the number of such experiences is limited compared with the ideas you can build inside your own brain.

Some ideas are revived perceptions, as was that of the orange; but this is not true of all. For while the mind can not create new images outright, nevertheless, when once we get a goodly stock of them, we can combine them, separate, and recombine them, without end. So, you can make mental oranges that are red, green, blue, purple, black, gray, white — something nature has never done.

It is just here that we so far outstrip the lower animals. We have more connecting fibers in our brains; and we connect our images more variously to make more new and original ideas.

Sensation. — There is no essential difference between a tone as it is sung into a good phonograph, and the machine's reproduction of that tone. So, there is no difference in kind, or quality, between an impression, which results from the stimulating of a sense organ, and the brain's reproduction of that impression in the form of an image. An impression and its image may be likened to a sound and its echo: both echo and image are the same as their originals, only fainter.

Now, impressions and images often mingle in complex ways, so it becomes convenient to have a word that includes both. That word is *sensation*. A sensation is either an impression or an image, just as a sound is either an original or an echo.

The "feelings." — Watch your mind as you read this stanza:

> "The day is cold and dark and dreary;
> It rains, and the wind is never weary;
> The vine still clings to the moldering wall,
> But at every gust the dead leaves fall,
> And the day is dark and dreary."

You get pictures, ideas, of rain, wind, old wall, falling leaves — but there is something more, a *feeling*.

A feeling is a like or a dislike, pleasure or displeasure in something.

> "Love to chawnk green apples an' go swimmin' in the lake —
> Hate to take the castor-ile they give for belly-ache!"

Here are the fundamentals of all feeling, the loves and the hates, the attractions and repulsions.

In common speech, "feeling" is used to refer to touch. Not so in psychology. For example, the psychologist never says, "The desk feels smooth." It ought to be correct to say, "The desk touches smooth," just as we say, "The lake looks rough," or "The meat cuts tough."

Later (in Chapter XIII), we shall study the various kinds of feeling. But just now we are after *elements*, simplest parts. What is there in a feeling that makes it different from a perception, or an idea?

Let your eye rest for a moment on various colors about you, one at a time. Select one that you like and one that you dislike. This simple bit of like or dislike that accompanies a sensation is the element we are seeking for. It is called an *affection*. Beware of the popular meaning of the word. An affection is the least bit of like or dislike.

In other words, it is an element of agreeableness or disagreeableness in our experience.

Sensation and affection. — Here, then, is what mind is made of, sensations and affections — nothing more. From the birth of the babe to the death of the adult, in dreaming or waking, from the depths of the sinner's sorrow to the heights of the saintliest joy, back of the fool's babbling and in the wisdom of the wisest, we shall find no consciousness so complex that it cannot be reduced and resolved into sensations and affections.

Let us compare the two. Sensation is a mental element that is referred to some particular bodily organ. Colors come to us by the eye, sounds by the ear. Affection is a mental element that is not referred to any special bodily organ. The bit of agreeableness or disagreeableness may seem to be in the tongue as we taste, in the nose as we smell, or nowhere in particular, a sort of feels-good-all-over experience, or the opposite. "A sight to delight the eyes," we say: yet we know the delight is not in the eye.

The sensation is definite, results from a definite stimulus on a definite sense organ. It is like a tap on a bell at a certain point. The affection is indefinite: it resembles the spreading thrill that vibrates throughout the whole bell.

Affection can never come alone, but only following a sensation. A sensation is the stimulus of every affection: you are never glad of nothing, but of *something*, something which comes to you in the form of sensations.

Finally, sensation is the mental element that stands for something other than itself, usually something in the environment. We may almost say that our sensations form

a kind of intermediate, neutral zone between the purely objective and the purely subjective. Affection is the mental element that has no direct objective reference. One laughs, another cries, over the same event: they get the same sensations from it, but not the same affections. The feeling each has depends very largely on his permanent brain set, and on his mental set at the time.

Properties of sensation and affection —By a property, we mean an attribute, trait, characteristic. Grass has the property of greenness, and yourself, the property of honesty. Now, what properties have sensation and affection?

Psychologists disagree here; but all can agree on this: whatever you study, mind or matter, a sensation or an affection, there are two great questions you should always ask about it. They are What kind? and How much? The first inquires about *quality*, the second about *quantity*.

The quality of a sensation or an affection is the property by which we recognize and name it. Red, green, sweet, hard, pain, hot, tone of middle C (on the piano) are qualities of sensation. We experience not less than fifty thousand different kinds. There are but two kinds, or qualities, of affection, the agreeable and the disagreeable.[1]

In dealing with sensations and affections, quantity is called intensity. The intensity of a sensation or an affection is the amount of it per unit of time. Pour out three glasses of water. Put two teaspoonfuls of sugar in one, four in the next, six in the next. Stir and taste. Sweet, sweeter, sweetest, hard, harder, hardest, painful,

[1] Some psychologists give more. See Josiah Royce's *Outlines of Psychology*, § 66; and Wundt's *Outlines of Psychology*, § 7.

more painful, most painful, hot, hotter, hottest, loud, louder, loudest, are degrees of intensity. They indicate that some sensations hit us harder, so to speak, during every second of time we experience them.

Elements and complexes. — While it is true that mind is made of sensations and affections, yet these elements never come to us singly, following one after another like a line of marching men. Our experience is made up of complexes. A complex is a group of elements. (The student of chemistry will observe that elements and complexes in psychology correspond to elements and compounds in chemistry.) So, an *impression* is an element; a *perception*, composed of impressions, is a complex. An *image* is an element; an *idea*, composed of images, is a complex. An *affection* is an element; a *feeling*, which always contains affection, is a complex.

Let us here begin an outline of the structure of the mind, to be completed as our knowledge advances.

MIND

Elements	*Complexes*
1. Sensations	1. Sense complexes
a. Impressions	*a*. Perceptions
b. Images	*b*. Ideas
2. Affections	2. Affective complexes

A sense complex is so called because sensations stand out the more prominently in it, as in a perception. In an affective complex, affection stands out the more prominently, as in a feeling of happiness. But there is no complex that does not contain sensations; and although perceptions and ideas have been spoken of as though composed

purely of sensations, there is probably no conscious state that does not carry some trace of affection.

Suggestions of synthesis. — You have now analyzed consciousness into its elements, its simplest parts. But mental life is a daily synthesis. The mind is a kaleidoscope that shifts its pattern every time a stimulus taps it. Even the very same elements can be composed into many different patterns. Your dinner would not seem the same if you began with the ice cream and closed with the soup; yet you still would get about the same impressions of taste as usual. "Old Glory," with the stars in the middle, would be another flag. The moving picture would be spoiled if the film ran through the wrong way. And "Annie Laurie" would arouse much less feeling if played backward, though we should have the same old impressions of sound, but in different order.

CLASS EXPERIMENT[1]

The purpose of the experiment is to study the affections aroused by colors.

Procure a 6×6-inch square of red, orange, yellow, green, blue, and violet papers. Arrange to expose two at a time through 4-inch windows cut near each other in a large gray cardboard. The cardboard should be mounted on supports. A flap of cardboard, fastened behind the two windows by a cloth hinge at its lower edge, will hold the exposed papers in position.

Take red as the first "standard" and keep it in the window at the students' left, exposing the other colors successively for a few seconds each in the other window. As each pair is exposed, the student will record which arouses in him the more agreeable affection.

[1] Adapted from Robert M. Yerkes's *Introduction to Psychology*, p. 156. Used by permission of Henry Holt and Company, publishers.

Each color in turn serves as standard. The whole process may then be repeated, but keeping the standard color on the students' right.

For scoring, each student will prepare two forms like the one below, but omitting figures and plus and minus signs. As each standard, whose name is at the left, is compared with the other colors, its horizontal column is filled with scores. *Plus* is a vote for the standard, *minus* is a vote for its rival. In case of no choice, record *zero*.

When the scoring is completed, add *plus signs horizontally* and *minus signs vertically*. To get from a score card the complete score for any color, add its score in the Totals column at the right to its score in the Totals column at the bottom. Thus, on the record shown, the total for red is 8; for orange, 1, etc.

	Red	Orange	Yellow	Green	Blue	Violet	Totals
Red . . .		+	+	+	−	+	4
Orange . .	−		−	−	−	−	0
Yellow . .	−	−		−	−	+	1
Green . .	−	+	+		−	+	3
Blue . . .	+	+	+	+		+	5
Violet . .	−	+	+	−	−		2
Totals . .	4	1	1	3	5	1	30

Each student will compute from his two record sheets the final score for each color, and some one may work out the totals for each sex, and for the whole class.

FOR FURTHER STUDY

1. We can teach a great deal of geography by means of moving pictures. Could we teach mathematics equally well by such a method? Why? Answer in terms of perceptions and ideas.

2. A student gave the following story from her childhood days. "One day Mother took me to a picnic, and when we were on the steamer crossing the lake, I cried because she would not allow me to get in the water. I said, 'O Mama, let me get off and walk, the

water is so nice and smooth.' " Explain the psychology of the situation. Do perceptions usually stand alone in the mind?

3. Name a number of images found in the idea of your home.

4. There are two kinds of mental element, sensation and affection. Experiment with a two-color kaleidoscope, such as you can buy at a toy store. Show how the mind is like a kaleidoscope.

Or, cut red and white paper into bits, letting the red represent affection, the white, sensation. Make a pattern to represent a thoughtful state of mind; a pattern of an emotional state.

5. Show how the popular use of the following terms differs from the psychological use: impression, image (remember, the image is *simple*), perceive, sensation, affection, feeling.

6. Should you rather endure the memory of a burn, or the original burn itself? Just why is this?

7. Explain, psychologically, the force of the following description. " The past, as it were, rises before me like a dream. Again we are in the great struggle for national life. . . . We see all the dead whose dust we have covered with flowers." Robert G. Ingersoll, *A Memorial Day Vision.*

8. " Impression must precede image." This is fundamental in teaching. Show why.

9. Galton calls attention to the fact that, since our language was formed by " barbarous ancestors," it is not well adapted to the expression of fine grades of difference. A pedestrian, asked to tell how heavy the knapsack on his back feels, " cannot find a reply in two words that covers more varieties than (1) very heavy, (2) rather heavy, (3) moderate, (4) rather light, (5) very light." Galton tried to form scales of descriptive words that would express more than five degrees of difference, but did not succeed; for what proved acceptable to one person was understood in a different way by others.[1]

Explain this in terms of intensity.

10. Select any object to be used in an object lesson for young children. What impressions must you give them in order to build up a complete perception of the object?

[1] See Francis Galton's *Inquiries into Human Faculty*, article on *Sensitivity*.

11. A celebrated Boston cook could "steal" the recipe for any dish by eating some of it in a restaurant. What mental abilities does this demand?

12. Give examples of ideas which are not revived perceptions.

13. What sensations bring your agreeable affections when you go in swimming? When you eat dinner?

14. Select some time when you have been unhappy, and trace out the sensations which brought the disagreeable affections.

15. Show by schoolroom examples that the perception of an object rouses more feeling than the idea of it.

16. Name all the feelings you can and point out the like or dislike, the attraction or repulsion in each.

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CHAPTER VII

GATHERING EXPERIENCE: HEARING AND SEEING

Exercises. — 1. Make a list of all the senses, so far as you know them. Check those that children use most in getting an education.

2. (*a*) Paint or otherwise apply a sample of color to a sheet of paper. Write an accurate description of the color and preserve the sheet. Record on it also descriptions of this color, given by your friends, independently.

(*b*) When you have studied this chapter, see if you can improve the above description. Just how many words (or symbols) are required to describe a color completely?

3. It will be good for you, at this point, if you can begin to use your eyes and ears as though you had never used them before. Practice for pure pleasure on colors and tones, as they do who have just received their sight or hearing.[1] Listen, with Riley, to the "husky, rusty rustle" of the corn, with Poe to the "tintinabulation of the bells"; and let your heart leap at the sunset, the autumn woods, and the emerald moss on the old gray rock. To one who can look and listen well, life is an endless succession of concerts and colored pictures.

Order of appearance of the senses. — It is said that sight and hearing minister to the soul, the other senses to the body only. Anyway, there was a time when the poor, struggling, evolving animal race had no eyes or ears. First of all came such senses as touch, warmth, cold, and pain; then taste, which is a kind of preliminary sample

[1] A man who had been blind from birth to age forty had cataracts removed from his eyes. "From the time when his eyes were unbandaged and he had exclaimed, 'I can see!' he became a changed man. His one object in life was 'to see.'" Edward A. Ayers, *First Sight at the Age of Forty*, Harper's Magazine, August, 1910.

of digestion; and smell, which is taste-at-a-distance, though the particles smelled must touch the smell-organ. Finally appeared the "distance-receptors," the ear and the eye. No longer need the animal grope and bump its way about the environment: it becomes aware of its pursuer or its prey while yet afar, and adapts itself to the situation in advance. Whether or not man will evolve more sense organs is a question for speculation.

These most delicate and most precious two not only evolved last in the race, but appear last in the development of each child, minister most to our highest mental culture, and give way first under the strain of old age. With them shall begin our study of the senses.

Physical and physiological sound. — This is no place to study physics and physiology, but we shall understand our psychology better if we observe what sound is, in the air and in the ear, before it appears as sensation in the mind.

This world is full of jars and shakes; and it is highly important for animals to be able to receive and interpret the small, far-traveling, warning vibrations, in order to avoid being jolted or crushed by more powerful quakes and convulsions near at hand. So, as ships are equipped with a vibration receiver to detect the approach of a submarine, nature has equipped her animals with such vibration receivers. Crude shake-organs, or jar-organs, are found along the sides of certain fishes. The grasshopper has his vibration organs, his "ears," under his wings. Man has his in his head.

The auditory nerve has two branches, the cochlear and the vestibular. The vestibular branch goes to the vestibule, and to the three semicircular canals which branch out

from it. In these canals are projecting brushes of fibers which, when the fluid of the canal is disturbed, are stimulated. These are man's original shake-organs, valuable now chiefly as balancing organs, organs of equilibrium. It is these that give us our sensations of dizziness, and which the child excites when he whirls round till everything else seems to whirl. There are three of these canals in each ear, one lying in each plane of space, as the three walls of a room come together in the corner. No matter how we move, then, the liquid in at least two canals (one in each ear) is sure to be moved. Subjects in whom these shake-organs do not function cannot be made dizzy by such whirling; neither can they sit a horse safely on the merry-go-round, or be sure of coming to the surface when they dive under water. Quite usually, they are deaf also, the whole ear being affected.

We have many nerves that respond to coarse shakes and vibrations. Even the deaf, at their asylums, are called from the fields by a steam whistle. They do not hear it; they " feel " its powerful vibrations. But it is the cochlear branch of the auditory nerve that thrills to the finer stimuli of this sort. This branch goes to the cochlea, or snail shell, where there is coiled a physiological harp of many strings. This minute harp is played upon by the vibrations of air that enter the ear, and responds, not by throwing out physical sounds of its own, but by sending impulses over the auditory nerve to the brain.

Of course, sound vibrations may enter the ear through other substances, such as water. In water, sound travels with great momentum, and may burst the ear drum. Bathers sometimes play cruel and dangerous " jokes " on

each other by clapping stones together under water when the ears are submerged.

Sound as sensation. — Sound is of two kinds, tone and noise. Tones result from vibrations that are regular, smooth, constant; noises from changeful, rough, irregular waves. Also, tones are more agreeable than noises, other things being equal. Noises, the pops, bangs, screeches, scrapes, thuds, groans, squeaks, booms, and roars, seem to be made of fragments of tones.

Quality and intensity of sound. — In psychology, the quality of a sound is its pitch. The higher the rate of vibration, the higher the pitch. Sing or play the scale, and you run through a range of qualities.

"Quality," as used in music, is also called timbre, or tone-color, and is that which enables you to tell whether a given tone, say "middle c," is whistled, sung, or played on this or that instrument. It depends on partial tones. When a string (for example) vibrates, it not only vibrates as a whole, but in addition, certain *parts* of it, the half, third, fourth, and so on, set up lesser vibrations of their own, whence come the partial tones. In the case of a voice, or a musical instrument such as the violin, these partial tones are all-important, as they make or mar the general effect. A tone quality, in strict psychological language, contains none of these partial tones, or overtones. Such a quality can be sounded from a tuning fork.

Intensity of sound is loudness. Hum a tone, or sound it softly on an instrument, and then sound the same tone loudly. The difference is one of intensity.

A chart of all possible tones. — Taking the vertical line in Figure 19 to represent quality, we can plot on it all

pitches heard by the human ear, from the lowest, which results from about 30 vibrations per second, to the highest, which enters our ears at the rate of 30,000 or 40,000 vibrations per second. Between these two extremes can be distinguished about 10,000 tones.

All these numbers vary with different individuals, and for the same individual according to age, health, etc. Galton found that the aged lose their sensitivity to high tones. (Read the account of his highly interesting researches in his *Inquiries into Human Faculty*, article on *Whistles for Audibility of Shrill Notes*.)

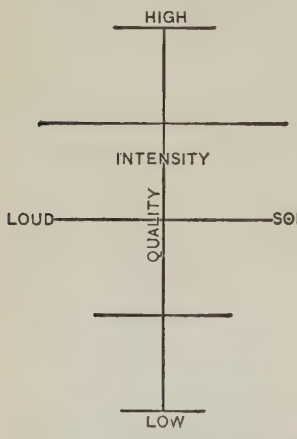

FIG. 19. — A chart of tone qualities and intensities.

To complete our chart, we should have to draw a horizontal line, an *intensity* line, for each of these 10,000 qualities. Only five are shown, and as the number of intensities of each tone is unknown, the lengths of these cross lines are uncertain; but as the ear is very much more sensitive to high tones than to low ones, these loudness lines must grow longer as we go up, until we approach the upper limit of hearing, where the number of different intensities is small.

Music. — Both as psychologists and as teachers, we are interested in the combining of tones to make music. This, perhaps the most complex of the arts, is determined by three simple factors, (1) rhythm (including "time"), (2) the choice of tones to be used, and (3) the gaps, or

intervals left between those tones when we combine them. As rhythm runs through all our experiences, it will be dealt with elsewhere (see page 130).

Of the 10,000 tone qualities, music employs less than a hundred, chosen from about the middle of the total range, where lie the tones of the human voice, and where the ear can make its finest discriminations. Of the many possible intensities, music uses but six, ranging from *pianissimo*, very soft, to *fortissimo*, very loud.

It is the intervals between tones, however, that have most to do with musical effect, which distinguish Oriental from Western music, and major from minor scales. We can picture the more common intervals as below, where the circles stand for notes, those in the upper line being a half tone apart.

Scales

Chromatic:	o	o	o	o	o	o	o	o	o	o	o	o	o
Major:	o		o		o	o		o		o		o	o
Harmonic Minor:	o		o	o		o		o	o			o	o
Melodic Minor:	o		o	o		o		o		o		o	o

The intervals, and hence the kind of music, that both nations and individuals prefer, is very largely a matter of habit.[1] Chinese and Japanese music differ from ours, and

[1] See how mechanically our Western musicians establish the "equally tempered" chromatic scale in common use: the a above c_1 ("middle c"), they have agreed, shall be a tone of 435 vibrations per second. Then of course the tone an octave higher has 870 vibrations per second. They now divide this whole interval of 435 vibrations into 12 equal parts, half-steps, and distribute the 11 intervening notes accordingly. Yet so "natural" does it seem to sing the major scale with half-steps between notes 3 and 4, and notes 7 and 8, that some actually assert the human voice to be constructed on this plan! If this were so, all nations and tribes would use it. Habit determines the matter.

both from each other. Even in chords, where perfection of harmony is determined by absence of " beats," fashion reigns. Modern ears can tolerate more beating, and find beauty in it, than could those of long ago.

Visual impressions. — If the colors seem a little complex, it is because nature has made so many of them, and has given us such wonderful eyes with which to view them. But we can greatly simplify our study by arranging the many thousands of colors into a system of some kind. Nature has begun the system by arranging the colors of the rainbow, and by giving us every gradation of gray from lightest to darkest as we pass from white daylight through the twilight hour into the blackness of night.

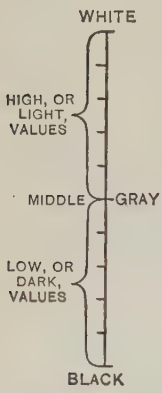

FIG. 20. — A scale to indicate the values of gray.

Let us begin with these grays. If we lay down black at one end of a scale and white at the other, filling in the dark grays, middle gray, and the light grays between, we find that the average eye can easily distinguish some ten steps of difference in passing from end to end of it. This is indicated in Figure 20. Middle gray stands halfway between black and white. All the grays above the middle are high, or light, values, and all below middle gray are low, or dark, values. This makes a value scale of 8 graduated steps from black through the neutral grays to white.

We are now ready to construct the *color pyramid* — for nothing less than a three-dimensional solid will enable us to show the three dimensions of color, that is, the three ways in which colors differ from one another. Taking the

scale of grays as our axis (having white and black as its poles), we build upon it our double pyramid of color. (See Figures 21 and 22.)

Such a solid includes all the colors with which either nature or art ever stimulates our eyes.

Now for the three dimensions of color, *hue*, *value*, and *chroma*.

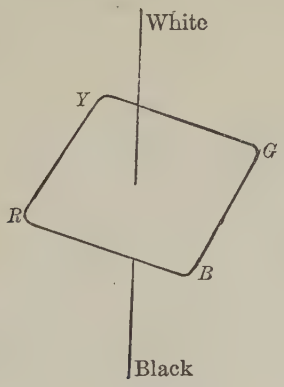

FIG. 21. — Base and axis of the color pyramid.

Hue.—Hue is what gives a color its place in the rainbow (or spectrum). It also gives to the color its common name. Experimenters have distinguished about 150 different hues; but the number of names in common use is much more limited. In Figure 21 appear the initials of four of the most used names, Red, Yellow, Green, and Blue. Lying between each pair are found, respectively, yellow-red (" orange "), green-yellow, blue-green, and purple-blue (" violet ").

All the hues, then, are found by following the outline of the base of the pyramid, as from *R* to *Y*, to *G*, to *B*, and finally back to *R* again. It is somewhat as if a rainbow had been wrapped around a figure whose shape approaches a square.

Value. — Value is lightness (or darkness) of color. On the pyramid, each hue grows gradually lighter from the base to the upper pole, gradually darker from the base to the lower pole. At the north pole is white; at the south pole, black. On the base itself are the middle values of all hues; above the base are the high, or light, values; below the base, the low, or dark, values.[1]

Chroma. — Chroma is strength (saturation) of color. In addition to being light or dark, hues are either *strong* or *weak*. With crayon or water color, lay down a strip of any hue of medium value on a sheet of middle gray paper. Make the color strong at one end of the strip, then weaken it gradually till it is lost in the gray of the paper. Or, if your "blackboard" is gray instead of black, as most slates are, you can perform this experiment easily, and accurately enough for practical purposes, by using the side of a piece of colored chalk. Here you have about the same hue and value throughout, but different chromas, saturations, strengths, of the color.

In the color pyramid, if you draw from any point on the surface (say *R*), a horizontal, it will pass through a similar succession of chromas, ending with some value of gray at the axis. The interior of the pyramid, then, is full of colors, of hundreds of hues, values, and chromas. On the axis are the neutral colors, black, white, and every value of gray between.

Consider further the location of the hues: as said above, we can find them all by following the perimeter of the common base of the two pyramids. But the hues so found are

[1] "Tint" is sometimes used to indicate light value, and "shade" for dark value.

of strong chroma, full saturation, like the colors of the rainbow, and of medium value. We can also find all hues by going about the pyramid above or below the base, along lines parallel to its sides, in which case the hues are a succession of light and dark values. Finally, we can find all the hues, in weakened chroma, by going inside the pyramid and following such a path as *R*, *Y*, *G*, *B*.

It will pay you to practice describing, in terms of hue, value, and chroma, the colors you would find at various points on and in the color pyramid.

Color as used in the schoolroom. — At the points of the pyramid, we find the extreme colors, the strongest that either man or nature has produced. But no artist makes much use of them. Our best pictures are painted in milder colors, that is, in weaker chromas, "subdued" by the mixing in of gray.

Young children, like all other instinctive creatures that have color vision, may enthuse most at first over the colors that are most flaring, just as they run after the blaring circus band. But it should be a part of their education to learn to appreciate the milder and more mentally hygienic colors, and to choose and use them.

Such taste and choice cannot be acquired by rule alone, but is a personal art, to be gained by long practice and criticism. From kindergarten to college, we exhort our pupil to express himself in agreeable tones and combinations of words pleasing to the ear; yet self-expression in color is more constant.

Let us make an equal effort to secure agreeable colors and combinations of color pleasing to the eye, on every wall and wayside, in all dress and adornment.

Physical and physiological color. — Physicists tell us there is a substance, called ether, much finer than air, too fine to be seen or touched, but spread throughout space. As physical sound is vibrations in air (chiefly), so physical color is vibrations in ether. These minute ether vibrations come pulsing into the eye at the rate of many billions per second.

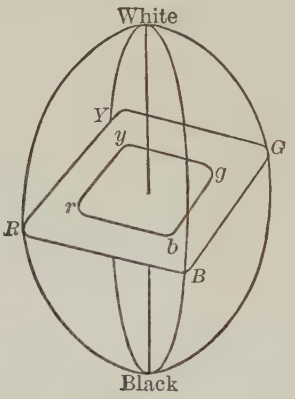

FIG. 22. — The color pyramid.

Further, ordinary sunlight is a perfect harmony of all the colors of the rainbow, with their various wave lengths, from the longest wave which makes red, to the shortest, which makes violet.[1]

With a triangular prism, you can break up sunlight into its various colors, as nature does in the rainbow. Observe the order in which they occur.

But the retina of the primitive eye responds only to

[1] The terms, tint and shade, are misleading, and their use should be discouraged. Avoid also the application of musical terms to color, such as "color tone," "pitch," "note," "painting in a minor key," etc.

black, white, and the grays. Such an eye saw just what the ordinary camera sees and photographs. The owl, the mole, and people who are totally color blind,[1] still have such eyes. In dim light, we are all "color blind," in a sense; for then very little or no chroma can be seen. Later in the course of evolution, there appeared on the retina a roughly circular patch of a substance which is sensitive to the yellows and blues.[2] Such an eye could see all colors except the reds and the greens. It is possible that even in historic times man has improved in color vision, for delvers in Homeric and Biblical research think they have discovered signs that the ancient writers had color vision less developed than ours.

Still later, probably, appeared another and still smaller patch of film, lying straight back from the pupil as you look into your neighbor's eye, and sensitive to the waves of red and of blue-green. Color vision was then complete — as complete as human beings have it.

We may call these three nearly concentric patches of film the white-black zone, the yellow-blue zone, and the red-green zone — though of course the films themselves are not so colored. Each zone can see all that any larger zone can see, but is blind to the colors that any zone smaller than itself can see. According to Hering's theory of color vision, now commonly accepted among psychologists, white, yellow, and red tear down, chemically

[1] There is such a thing as color blindness which depends on the brain instead of the eye, but it is extremely rare.

[2] The color names are here used to indicate large sectors of the color pyramid. "Yellow" includes, roughly, all the colors in the neighborhood of yellow.

decompose their respective films; and black, blue, and green build them up. Observe how tiresome are much bright white or strong red or yellow in your surroundings. You never paper a room with such stimuli, nor use much of them in your everyday clothing. Our eyes are " beautifully adapted to look long at the canopy of blue above us and the sheet of green below."

If either the tearing down or the building up process is carried to an extreme, its opposite begins. Look steadily at a patch of red for fifteen seconds, then shift your gaze to a point on a sheet of middle gray 8 for a few seconds more. The retina starts the building up process, and this *is* the seeing of blue-green, so far as the eye is concerned. Such an after-impression is commonly called an " after-image." If it is the opposite of the original, as in this case, it is called *negative;* if it is a continuation of the original, as when a whirling spark seems to be a circle of fire, it is called *positive.* The " tail " of a rocket is chiefly positive after-impression.

If equal and opposite stimuli fall alternately on the appropriate zone, — for example, if the color wheel causes equal areas of red and blue-green (of proper value and chroma) to stimulate alternately the red-green zone, the building up and tearing down are equal, as when a man lays up bricks with one hand and lays them down with the other. The result is nil: one sees middle gray. This results from the usual action of the brain cells, and is just what a blind man sees all the time, in so far as he sees anything.

CLASS EXERCISES

1. Gaze at patches of various colors about 15 seconds each and then project the after-sensations on a sheet of middle gray. Do not permit the gaze to wander.

Try to formulate a law that will enable you to predict the after-sensation of any such stimulus.

2. Show (roughly) that if any two colors of the pyramid are mixed on the color wheel,[1] the resulting color lies on the straight line that joins the two, and at a distance from each which is inversely proportional to the amount of each color included.

3. Find or make pairs of colors which, when mixed about half and half on the color wheel, produce approximately a middle gray. (Such colors are called *complementary*.)

Show that this is simply a special case of the law of mixture, given above.

4. Illustrate change of *value* in any color by adding white or black.

Illustrate change of *chroma* by adding gray of about the same value (that is, of about the same level in the color pyramid) as that of the color itself.

Using disks of different diameter, change the *value* of the smaller red by adding 50 per cent of white, and the *chroma* of the larger red of the same hue by adding 50 per cent of gray. Display them together on the wheel.

FOR FURTHER STUDY

1. Suggest all the facts you can think of to explain why tones should ever have come to be called "high" and "low." Where do the height and the lowness come in?

2. If you have an opportunity to hear Indian or other unusual music, try to explain its effect in terms of rhythm, choice of tones, and intervals.

[1] An inexpensive color wheel can be obtained from dealers in kindergarten materials. It is well to have two complete sets of disks, of different diameters.

3. Sound makes no noise in the brain. Analyze this confusing statement and show that it is based on the difference between physical and mental sound.

4. Whirl about with your head in different positions, (*a*) upright, as usual, (*b*) face upward or downward, and (*c*) reclined nearly on the shoulder. Notice, in each case, how things seem to move when you stop. All depends on which semi-circular canal you stimulate, and the direction in which its fluid tends to move. Try to work out a law for this, so you can predict what will happen in any case.

Is it any wonder that the whirling dervishes can bring on a sacred fit in this way?

5. Observe the affective value of tones, especially of voices. Which do you like, which dislike? How do you want your voice to sound when you teach?

6. Practice bounding the hues. Thus red lies between red-blue (violet) and yellow-red (orange).

7. Draw and carefully color (*a*) a cross-section through the base of the color pyramid; (*b*) any cross-section you choose that cuts the axis lengthwise.

8. Make a colored drawing to include all the blues.

9. Can you explain now the ghost you saw on an earlier page (page 45)?

10. Describe completely and accurately many colors that you find in nature, clothing, decorations, etc.

11. Select pictures whose color combinations please; others (such as those found in certain Sunday newspapers) that displease. Study the colors and try to explain the effect.

12. Every human complexion can be matched by combining red, yellow, white, and black (or some of these) in the right proportions. Has this any significance for dress?

13. Would not the United States flag be more artistic if its chromas were weakened? Do you wish them reduced? Why? What is a flag for, primarily? Consider its area as compared with its usual surroundings.

14. Take in your right hand a piece of red of medium value and strong chroma. Keeping your eye fixed on some point in front, ex-

tend the arm backward and then bring the red slowly around toward the front. Can you see it as an object before you can tell its color? Can you tell when the rays of light from it are crossing the yellow-blue zone of your retina? Try this with other colors, and on other people, who do not know which color is to appear.

15. The most common form of color blindness is blindness to reds and greens. What is the meaning of this? Which color film of the retina is the smaller? The more likely to be absent or defective?

16. Why do oculists prescribe blue, green, or gray glasses for sensitive eyes? Why not white, yellow, or red ones?

17. "A is the standard pitch, having 435 double vibrations per second at a temperature of 68° Fahrenheit. Many pitches have prevailed in different countries at different times. At the time of Handel and Mozart, the pitch was lower (422.5 and 421.6). England has had the pitch run as high as 454.7 and the United States as high as 460.8." (Quoted from Gardner, p. 48. See References.) How do you explain this?

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CHAPTER VIII

GATHERING EXPERIENCE: IMPRESSION AND PERCEPTION

Exercises. — 1. Analyze the "taste" of ice cream. In other words, make a list of all the impressions you get by way of the mouth when you eat ice cream. Should you like it as well if it were as hot as coffee? If it were black and brittle like anthracite coal?

2. Place an object, such as a button or a coin, in an ordinary washbowl. Step back until the object is just out of sight behind the edge of the bowl, and then have some one fill it with water. Now take a pointer and thrust the end of it in where the object seems to you to be. Did you touch it? Explain. Of course, the water bends the rays of light; but this is the *physical* part of the explanation. Why did you not see the object just where it actually was, in spite of the bent rays?

Having studied hearing and sight, we shall now take up the remaining senses.

Gustatory impressions. — To the primitive animal, taste is the fore-test of digestion: what smacks well in the mouth sits well in the stomach. And this is true of man when he follows his appetite carefully, rationally, introspectively. But our cookery is too often the art of bribing the tongue instead of serving the stomach. It might be better if we were more like the amœba, which probably gets most of its taste experiences while digestion is going on!

Observe the tip of your tongue and you will find it flecked with small specks of strong pink. These are bud-like formations, called taste buds, lodged in the walls of the furrows of the tongue. In them are spread out the fibers of the three nerves of taste. These buds are found chiefly

at the tip of the tongue, where we taste sweet best; at the back, where we taste bitter best, and at the sides, where sour is strongest. Salt can be tasted at all three points. All our complex tastes can be reduced to these four simple ones — sweet, bitter, sour, and salt.

Much of what we commonly call taste is touch, temperature, or smell. If we hold our noses, medicine does not "taste" so bad, and potato can scarcely be distinguished from apple. Yet the sense can be cultivated to extreme nicety. There is a story, which appears to be reliable, of two expert winetasters who shocked a wine merchant by tasting, one leather, the other, iron, in his finest wine. Later, a tack with a leather head was found in the cask. The sense repays reasonable cultivation by its aid in testing food, chemicals, and the like.

Olfactory impressions. — To the lower animals, smell is indispensable, and so is constantly sharpened by exercise. The dog can track his master by smell, but the master can hardly track his dog by this method. Smell, as Titchener says, is a "ground sense."[1] It is found at its keenest and used most by those animals, such as the dog and the cat, whose noses are constantly near the ground, and which depend on their sense of smell to get them a living. Evolution, in giving man an erect posture and an upward gaze, has lifted his nose from the ground and given him less use for smelling. But if we feel above those humble animals which do so much nosing around, the birds may feel superior to us, for at their height they have so little use for smell that they have almost lost the sense, and so depend on their eyes and ears instead of their noses.

[1] Edward Bradford Titchener, *A Beginner's Psychology*, p. 50.

But this humble sense is well worth cultivating: it is useful in cookery and chemistry and many other undertakings. Aside from the charm of agreeable odors, there are many practical situations where health or even life itself, may depend on the sense of smell.

Round every odorous body is a cloud, usually invisible, of floating particles that enter the nostrils and make contact with two little smell spots, sensitive patches of mucous membrane lying up in the dome of the nasal passages. As the smell spots are above the usual breathing currents, we commonly carry the stimulus up to them by sniffing.

If smells could only be classified and systematized, like tones and colors, we might be able to produce a perfect concord of sweet smells, a music of odors; but they are very numerous, and so far, they seem as vagrant and unrelated as random tones and colors must be to a little child.

Many smells are markedly agreeable or disagreeable. But odorless air is best, not laden even with a sweet smelling savor. Foul smells often cause immediate nausea — nature's warning that back of the ugly odor there is probably something injurious to general health. In the schoolroom, we must make every effort, by health, cleanliness, and ventilation, to keep the air so fresh and pure that it is odorless.

Impressions from the skin. — The skin gives us touch, warmth, cold, and pain. So do many other organs; but we are especially interested in the skin because it stands, so to speak, between us and the outside world.

The nerves of these senses come to the surface — or near it, in spots, irregularly distributed, for the most part,

and varying in number on different parts of the body. On the average, we have, for every warmth spot, ten "cold spots," ten touch spots, and forty pain spots. The tip of the tongue and the finger tips are most sensitive to touch — and most mobile, let us observe.

All these nerves, except those for pain, have special ends, "corpuscles," "bulbs," and so on. The pain nerves simply taper to an end. Pain, then, is a sensation which results from the stimulating of "free" nerve endings, as they are called. It includes itch, prick, and ache, as well as common pain, and may be agreeable or disagreeable. Pain is frequently confused with disagreeable affection, and hence the word is commonly misused. Pain is not the opposite of pleasure.

It is very important for the teacher to know that we cannot trust our temperature sense in judging the heat of a room. What we experience is the temperature of our *skin* rather than that of the surrounding air, and they are not always the same. In every living room there should be an objective standard in the form of a reliable thermometer, to guide us.

All other skin experiences, such as wetness, roughness, tickle, and burning, are complexes, and include no impressions outside of touch, warmth, cold, and pain.

The tactual-motor sense. — Touch, and especially the intense form of touch called pressure, is not confined to the skin. In the tissues beneath the skin, in muscle, tendon, joint, and bone, are special nerve-endings sensitive to contact and pressure. These give us our sensations of resistance and movement, called kinæsthetic sensations. The kinæsthetic sensations include *pressure*, the *strain* of

resistance (as that experienced in a finger joint when we pull it), the *effort* of active movement, and *fatigue*.

These kinæsthetic senses, acting with those of the skin (especially touch), form what may well be called the tactual-motor sense, the touch-movement sense. In estimating the weight of objects, you can do better by lifting them than by letting them rest on your motionless hand. In judging extent of movement, you can do better when you move across the object than when the object moves across you. Tactual-motor sensations from about the joints tell us, even with eyes closed, how far the limbs have moved. The joints most sensitive to angular movement are the wrist, shoulder, and those between hand and fingers. The elbow and joints within the fingers are less sensitive. Such sensitivity is greater for rapid than for slow movement. Every part of the body has greater discriminating power when permitted to move. The moving hand is the most sensitive exploring organ we possess.

Probably the value of the tactual-motor sense, both in and out of school, is commonly overlooked. In dressing, eating, writing, moving about, we constantly depend on it. Men can learn to shave and women to adjust hair and hats without a mirror. The fingers of the violinist "have eyes" that guide him better than his real eyes possibly could. A rat, deprived of sight and smell, can beat a human being who has both, in learning the way through a labyrinth. Touch typewriting and touch piano playing are not difficult. Nor can the blind excel us in tactual-motor accomplishments when we exert ourselves.

Organic impressions. — These are sensations from the maintenance systems of the body, the digestive, circulatory,

respiratory, excretory, and reproductive systems. Hunger, thirst, nausea, suffocation, and the like belong here, either as elements or complexes. Thirst is due largely to the drying and contracting of the mucous membrane of the mouth and throat. Hunger is caused principally by contractions of the stomach. At the Harvard Medical School, a student swallowed a rubber bag, which was then inflated through its attached tube. The subject pressed a lever at the intermittent onsets of hunger. The movements of this lever followed those of another which, out of sight of the student, registered the pressure of the stomach on the inflated bag, showing that the sensation of hunger and the contraction of the stomach occurred together.

Organic sensations have a variety of stimuli, food in the stomach, cold air in the lungs, changes in circulation, etc. They are for the most part rather vague, hard to localize and to analyze, but important because they signify so directly the well-being or ill-being of the body, and contribute so much to our emotions.

Laws common to all impressions. — A sensation is not, of course, a fixed *thing*, carried bodily from the outside world into the mind. It is a process, and so a kind of compromise between the stimulus and the *condition of the nervous system* that receives it. The same stimulus may produce different results, chiefly according to the following laws.

Adaptation. — Long stimulation is followed by a fading impression. The nose soon adapts itself to odors, sweet or foul, and we cease to smell them. Teachers and pupils become adapted to an overheated schoolroom, to the detriment of their health. Stare at a point in the landscape for a minute or two and its colors fade. Stay in a

room that seems at first blindingly light or dark and you will soon be able to see. If sweet were always in the mouth, there would be no sweet. If we want to be extreme and paradoxical, we may say that to have an experience all the while is not to have it at all.

Contrast. — Opposites enhance each other. This applies to both quality and intensity. Red cheeks look redder against a green gown and hat. Frosty air makes fire welcome. Spring out of doors makes the schoolroom dingier than ever. Sweet, lingering in your mouth, makes sour more sour. The bright and the dull increase each other. Only as contrast breaks up adaptation can we hope for variety of experience.

Facilitation and inhibition. — One stimulus may strengthen, weaken, or destroy the effect of another, as already shown (see p. 64). The second flash of light or the second calling of our name may rouse us when the first one fails to do so. The first stimulus seems to clear the nerve channels for the second. Or the two stimuli may come together. Laying your hand on a pupil's shoulder and speaking to him at the same time make each more effective.

On the other hand, complementary colors may destroy each other and give no color. Hot coffee kills all cooler tastes. Dazzling light excludes all else. A mischievous boy may extract a hair without the victim's knowledge by rapping him sharply on the head as he pulls. In the schoolroom, it is a rare page of print that can compete with loud noises.

Impressions fuse to form perceptions. — We have already found that a perception is a unified group of im-

pressions. But the impressions do not group themselves mechanically, each maintaining a square-faced independence, like so many bricks forming a wall. They are more like currents of colored water or beams of colored light, which mingle, change, and even suppress each other.

A peach falls from the tree with a soft thud (auditory impression). You pick it up and dent it with your thumb (tactual-motor impressions), gaze at its beautiful colors (visual impressions), smell and taste it (olfactory and gustatory impressions). But ordinarily, you make no such careful inventory of impressions. They flow together into the one experience, *peach*. A young man who was suffering a touch of love at first sight was asked the color of his lady's eyes. He was unable to tell, although he had been in her presence for hours.

How much or how little is included in one grasp of perception depends on one's state of mind, especially his purpose. The fruit buyer may take in a carload of peaches at a glance; the housewife, a quart; the artist, a group of two or three; the biologist, a single cell of peach pulp. Every teacher should practice looking over the heads of her pupils until she can see her whole room at a glance.

Classes of perception. — Perceptions are often named according to the class of impressions that predominate, as olfactory, or gustatory. Most prominent are the visual, auditory, tactual-motor, and mixed. A mixed perception is one composed of a goodly proportion of various kinds of impression, as that of the peach, described above.

Perceptive types. — Corresponding to the chief classes of perception are the types of perceiver, visual, auditory, tactual-motor, and mixed. In the case of the great ma-

jority of children, learning flows in fastest and best through the channel of the eye — note how much eye learning there is in the average schoolroom. But the increasing emphasis on manual training, domestic art, play, gardening, and the like, is an indication that in the old-fashioned school, tactual-motor learning was all too rare. The younger the child, the more of a tactual-motor learner he is likely to be.

False perceptions. — Ordinarily, you expect your news to be true news. But the old symbols or signals, sent in in the old way, are sometimes deceiving, as when a false fire alarm is turned in. It sounds the same, at headquarters, as a true alarm, and the firemen respond in the same way.

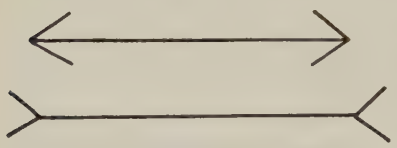

FIG. 23. — The Mueller-Lyer illusion.

Similarly, the brain may be deceived. When you see a crooked stick lying across the dim wood path, you may have the very impressions that ordinarily mean " snake," and the brain responds as it would if you had actually seen one. The well-known Mueller-Lyer illusion is given in the figure (Fig. 23). The horizontal lines, really of the same length, appear of unequal lengths because of the angles at the ends, which urge the eye to " go on " or " hold back."

A false perception of a real object is called an *illusion.*

A *hallucination* is a false perception of an unreal object. One who is drunk or highly nervous may see snakes where there are none — not even crooked sticks. The dead have been " seen " in open daylight, alive and active, by persons otherwise normal. Students, sitting in their own rooms,

have spoken to friends whom they "saw" entering, when those friends were certainly nowhere about.

But usually there is some objective hint of the object supposedly perceived. Enlarged blood vessels in the eye may be projected as snakes. Clouds suggest angels. The white streak becomes a ghost. The essential condition is that the brain tract in which a certain idea is recorded shall be so excited as to make that idea "as real as life," that is, as intense as a perception, whereupon it can readily be projected and mistaken for one. Occasional experiences of this kind are quite common; but frequent or persistent hallucination is a strong symptom of insanity — *is* insanity, in fact.

Strictly speaking, the illusion and the hallucination are not false perceptions, but false *ideas* started by a perception or other objective suggestion. There is no sharp dividing line between them: the illusion shades into the hallucination, and this into the delusion. A delusion, as James says, is "a false opinion about a matter of fact," as when the insane patient thinks himself a king.

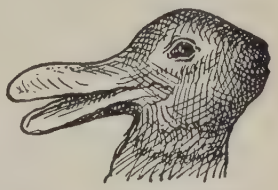

Fig. 24. — Duck or rabbit?

Apperception.—This overworked word has many meanings, too intricate and rambling to be discussed here. The essential fact is this: we perceive according to our past. Nerve paths have been opened by old experience, and new perceptions follow the law of least resistance. This causes certain determining impressions to stand out and fix the general character of the whole perception. An old but good example of this is given in the figure (Fig. 24). It is perceived as duck or as rabbit according to the post of the perceiver. Most of

us, who are familiar with both duck and rabbit, can make it shift from one to the other under our eyes.

The child who calls a fern " a pot of green feathers," who speaks of roast chicken as " hen-beef," or (being familiar with locomotives) names the steamboat, coffee pot, spirit lamp, or anything else that hisses or smokes, a locomotive, or applies the term " star " to the candle, gas flame, and the like, is apperceiving, " interpreting the new by the old." [1]

Note that apperception depends on the *ideas* present, rather than on the perception pure and simple. Whenever impressions enter the mind, they are met by a rush of old friends, namely, the images that have previously been associated with these impressions. It is largely this reception committee of images which steers the course of the apperception.

Perception of rhythm. — Rhythm lies deep in nature. It is the pulse of her heart. We find it in the speeding and slowing of the earth in its course round the sun, in the ebb and flow of tides, in the seasons, in our heartbeat, our footfall, our daily rise and fall of energy, our pulses of mental effort.

Rhythm, considered subjectively, is the regular repetition of experience. There is a rhythm of time and of space. Temporal rhythm is best illustrated by the flow of sounds in music and in poetry. Spatial rhythm appears in the regular recurrence of columns, arches, windows, spires, and other units used in building. Architecture is indeed " frozen music." We dislike big blank areas of wall: the music must not be all rests.

[1] These illustrations are taken from T. G. Rooper's *A Pot of Green Feathers*. Every teacher should read this delightful and enlightening monograph.

It is interesting to note how rhythm, and especially accented rhythm, flows through our common life. The march, the dance, the flowered paper on the wall, friezes and frets, designs in tiles and in carpets, the chant, the song, the poem — all show how deeply rhythm throbs through our natures.

Perception of space. — If we take an inventory of the senses, we find two only which help us much in determining how the outer world is arranged around us. These are sight and the tactual-motor sense.

Two observations are important:

1. A two-dimensional sense organ enables us to perceive two-dimensional space [1] (that is, plane surfaces). A patch of skin, like the retina of the eye, is spread out so as to enable us to perceive length and breadth; but neither tells us anything of the third dimension, distance out from the body. If we had to perceive the world through such a patch of skin, or a retina, *fixed in its place*, we might work out plane geometry, but of solid geometry we should have no idea whatever.

2. Only movement (including movement of the eyes and the small muscles connected therewith) can tell us of distance out from the body. The baby reaches for the moon, actually expecting to grasp it, as he does his balloon. The born-blind, on receiving their sight at maturity, think all objects close to their eyes, and keep their hands up for

[1] Provided the points in the sensitive surface of the sense organ can be so stimulated as to make them correspond to the points in the surface perceived. The smell-patches in the nose present a sensitive surface spread out in two dimensions; but they are stimulated by a puff of odorous air, and not point by point.

protection as they go about. One such subject, on seeing a picture, painted in perspective, ran his hands over it and then asked which was the lying sense, sight or touch, explaining that his hands made it out to be flat, while his eyes saw it as stretching off a great distance from him.

Observe that the "movement" which alone gives us information of distance out from the body, includes muscular contractions which are very minute, very obscure, but very significant. Such are the movements of the muscles of the eyes, especially those which converge the eyeballs and focus the lenses. With practice, our judgments of space, based on such minor movements, come to be very accurate.

The big lesson for us teachers to learn from the study of space perception is the importance of tactual-motor impressions in getting our bearings in this world and estimating its distances. Only by pushing our way through space do we ever come to know space thoroughly. See how much your shop-loving, bicycle-riding boy beats the library-haunting girl in estimating distances and measurements of all kinds. The school must have plenty of movement in it if it aims to make its pupils experience the world as well ordered in space.

CLASS EXPERIMENTS

Testing the Range of Perception

1. Make a tachistoscope by fastening two four-foot uprights one foot apart, so as to support a sliding board three feet long. At the center of the board, cut out a square of ten-inch side. On white, foot-square pasteboards, leaving a margin of two inches, paste (*a*) squares of black paper, (*b*) large black letters, (*c*) short words, (*d*) pictures of objects, or (*e*) patches of different hue, all in a non-

symmetrical pattern. All should be clear to the eye, across a room. A series of each kind may be prepared, so as to expose anywhere from three to ten objects when the board falls. Two feet from the floor, fix a support for these pasteboards.

Raise the slide. (It may be held by a nail which moves through the upright.) Then fix a cardboard in place. Let all gaze where they know the cardboard to be. (A tack or a bit of paper will fix the gaze.) Drop the slide. (Felt placed beneath it will deaden the noise.) Let all record what they have seen, after which the instructor will state the number of objects actually on the card. Record this also. The average for the class may be computed at the close, taking from each student the highest number he perceived correctly every time.

2. The ear may be tested by one-to-several tones produced simultaneously on harp or piano, or by noises of various sorts. What is the greatest number of tones that a musician should put into a chord?

3. Thrust pins slightly through a cardboard, keeping them about one eighth of an inch from each other. Make groups of from one to eight. Test as to the number distinguishable by a finger tip. How many points can safely be used in forming a raised alphabet for the blind?

Would practice be likely to extend the range of perception? How could you find out?

4. Procure one or more stereoscopes and make views for them. Paint fields of complementary colors before the two eyes. Or, draw a bird on one side and a cage around the corresponding space on the other, etc. Each student may invent an original view. Can we perceive with each eye independently, both being open?

FOR FURTHER STUDY

1. Make a table of all the sense organs, their stimuli, and the class or classes of sensation which they yield.

2. Classify stimuli. They are commonly set down as mechanical, thermal, electrical, chemical, and photic. Do you agree?

3. Give an account of the impressions that guide you when you go up or down stairs in the dark.

4. Why should we have so many pain spots in proportion to touch and temperature spots? Can you see any use for pain?

5. Close your nostrils and let a friend place samples of different food on your tongue. Can you tell what you are tasting?

6. Do you know of any national smells or tastes, as we have national colors and music? Why is this?

7. Chart the impressions received from the skin, as you did those from the ear. Remember there is but one quality of touch, of warmth, and of cold. There is disagreement as to whether we experience more than one quality of pain. What do you think?

8. You are caught in a shower and get disagreeably wet. Is this "painful"?

Can the hero properly be said to be "pained" when the heroine refuses him? How is he affected?

9. Why does a dental cavity, or the place of an absent tooth, seem so large when explored by the tongue?

10. When you enter your room, especially if you are very warm or cold, can you tell the temperature accurately by your impressions? Have you a thermometer in your room?

11. Try to analyze such experiences as wetness, roughness, tickle, and (painful) burning, into their constituent sensations.

12. We cannot see our mouths. Why do we not need mirrors to enable us to deliver the food into them? Can the young child locate his mouth easily?

13. Do you know of any part of the body that cannot serve as sense organ?

14. Close your eyes and bring your index fingers together in front of you; back of you. Comment on the result.

15. Estimate several distances (as the lengths of strings or pieces of paper or wood) by sight, and then by touch. Which set of estimates is more accurate in your case?

16. Why do you not experience the touch of your clothing all the time? Why do you lose hearing of the train or automobile in which you ride?

17. Why does the night seem darker just after a flash of lightning?

18. Look up the derivation of the word *apperception*. Show how the root meaning applies.

19. A countryman, on seeing a bicyclist for the first time, described him as "a straddle-bug, mounted on nothin', and clawin' away like all possessed." Explain.

20. What was the apperceptive trouble in case of the man who, after gazing at a rhinoceros for some minutes, exclaimed, "Gosh! there ain't no such animal"?

21. Why is it so difficult to keep from stepping to a well-played march?

22. "Only movement can tell us of distance out from the body." Give a detailed account of the experience necessary before a person can say (truthfully), "I believe I see an apple about ten feet away." How came he by the idea of ten feet, *originally?*

23. State any differences you have observed among individuals as to their preference for the use of one sense rather than another.

If you wished to impress a piece of music on your mind, should you rather see the notes or hear them played? Why?

24. Mention kinds of school work in which the tactual-motor sense would be of value.

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CHAPTER IX

RECORDING AND REPRODUCING EXPERIENCE

Exercise. — How can you memorize fastest, through the eye, the ear, or the hand? To help you answer this question, memorize the nonsense syllables given below. So far as possible, stick to the syllables themselves and pay no attention to what they suggest. (For example, sov might suggest sovereign.) Note the time required in each case until you are just able to repeat the list correctly. Rest a little between tasks.

First, to familiarize yourself with nonsense syllables and get practice on them, memorize the following list by the method you commonly use: var, mup, tib, sov, raz, bal, vej, zik, tev, kes.

Now, memorize the following by using the eye only, picturing each word carefully: rad, guf, dut, nib, wap, cag, taz, ber, fon, tig.

Have some one read to you the following list at the rate of about one per second, repeating the reading until you can give the whole correctly: tol, kuf, jer, kus, pif, geb, mez, fex, reg, fik.

Finally, copy the following repeatedly until you can give them without error: ren, sur, kep, luf, dar, kam, tuc, sor, lod, zan.

Which method do you find more rapid? Which most fatiguing? One hour later, which list can you best recall as you run through it, uncovering each syllable after you have tried to give it?

Do you think this should be regarded as conclusively showing the best way for you to memorize? Why?

Tabulate the results for the class. What per cent succeed best by the eye method? the ear method? the tactual-motor method? What does this suggest as to the best way of teaching most children?

As already stated, the brain (1) gathers experience, (2) records and reproduces experience, (3) analyzes experience, (4) synthesizes experience, and (5) expresses

experience in behavior. We have studied (in Chapters VII and VIII) the gathering of experience through the sense organs. We take up next the recording and reproducing of experience. In other words, we shall now study *memory*.

What if we had no memory? — We have likened the brain to a moving-picture factory. In the sensitive film there used, the pictures are preserved, and may be reproduced at will. But if we had no memory, the brain would be like a looking-glass, picturing everything that came before it, but only so long as that thing was present. No image would remain to represent the object when it was taken away. Close the sense organs, and the brain would be as blank as a mirror in the dark.

A man without a memory would have no idea of yesterday or of to-morrow. A nation of such people would have no conscious history or anticipation of a hereafter. There would be practically no imagination, nor continuous thought, nor science, nor preparation for the future. In our conduct, we should be as helpless as feeble-minded children.

Because of this, certain mongers of memory systems make such extravagant declarations as that "you are no greater than your memory." They might as well say you are no greater than your bank account. Memory, like money, is indispensable in moderate amount; but one may easily spend too much time accumulating. We show our caliber by the use we make of what we have.

Of course, as James says,[1] it is the man whose learning *sticks* who can keep building on it and advancing. But he

[1] *Principles of Psychology*, Vol. I, p. 60.

warns us that mere native tenacity will not make one great unless backed up by unusual feeling and extraordinary intelligence. He quotes the case of a young man who had with difficulty been taught to read and speak, yet who could so mentally photograph an ordinary page of print by two or three minutes of study that he could then spell out the words from memory as well as if the book lay open before him. A second example from the same author is that of a Pennsylvania farmer, almost blind, who could recall the day of the week for each date of over forty years, the nature of the weather, and his occupation on each day.

What is memory? — Memory, like habit, depends on the fact that the nervous system preserves in itself a record of what it has gone through, tends to do again what it has done before. The sounding boards of violin and piano preserve in their structure the results of past activity and throw back the general quality of the notes to which they have vibrated most frequently. Paper, once folded, folds again accordingly. The stream glides easily in the old channel. The knife blade, once magnetized, holds its new behavior for long. The brain, once thrilled by an experience, may reproduce it indefinitely.

It is the brain, then, not the mind, that remembers. The brain is the candle: mind, including our remembered experience, is the flame. Memory is the power of the brain to record experience and reproduce it. Or, expressed more precisely in terms of mind, we may say memory is experience recognized as reproduced.

Experience may be repeated from the brain records alone, in the form of *ideas*, as when we say over some old,

familiar gem of poetry; or in the form of *perceptions*, as when we realize, on traveling a certain road, that we have passed over it before, though we could not have described it. So, a song sung to us may be recognized as old, though we could not have revived it from our brain records.

When we wish to be very accurate, it is well to use the word " recognize " if the experience is repeated in the form of perceptions, reserving the term " memory " to indicate the reproduction and recognition of ideas. We should hardly be willing to say that a child remembers his multiplication table if he merely recognizes it when it is shown to him in the book. The word " recollect " is used to refer to the very definite and detailed placing of an event in one's past, as when a witness recollects the exact day of an event, where he was going, whom he talked with, etc. You may remember the multiplication table without being able to recollect just where or when you first saw it, or learned it.

The subjective mark of memory. — Stop and perform an experiment. How do you know, without appealing to an objective record of any kind, what you were doing yesterday at this hour? " I was here, studying psychology," you say. But how do you know? " Why, the fire whistle blew," etc. But perhaps you are *imagining* all this. What makes you so sure that it all happened yesterday?

Psychology is forced to conclude that what makes us sure of ourselves in such cases is the *feeling of familiarity*. In the figure (Fig. 25), E is any experience, such as yours yesterday at this time. E' is a repetition, more or less

exact, of *E*. But *E'* brings with it something additional to *E*, and that is *F*, the feeling of familiarity. This is the subjective sign that tells us we are really remembering.

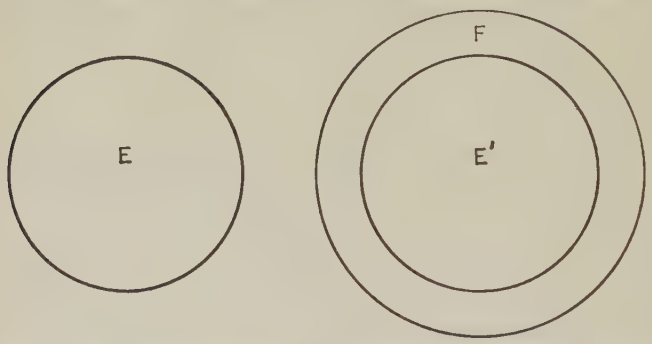

FIG. 25. — *E*, any experience. *E'*, this experience repeated. *F*, the feeling of familiarity.

This feeling of familiarity may be present in any degree, from the mildest flicker to the strongest flame. Titchener says that in experiments on the recognition of grays, he "has reported positively that a particular gray had been seen before, without being able to find anything whatsoever, in the way of verbal idea or kinæsthetic quiver or organic thrill, that might carry the meaning of familiarity; the brain habit just touched off the report 'Yes,' and that was all that could be said."[1] Such recognitions are characterized, not so much by the presence of a feeling of familiarity as by the absence of the feeling of strangeness, unfamiliarity, which we expect with experiences that are new.

But even when the feeling of familiarity is strongly present, our memory may be false to the facts. Children,

[1] *A Beginner's Psychology*, p. 182.

especially if led on by suggestions or swayed by interest, may be emphatic, erroneous, but perfectly sincere reporters of their past.

There is no single memory center in the brain. — Memory is all too commonly thought of as a single faculty, or power, lodged in some particular lobe of the brain. But plasticity, in the sense of remembering power, seems to be found wherever mind is found. The brain does its bookkeeping, so to speak, right where the business is transacted: the part of the brain used in experiencing a thing is the part used in recording that experience. An injury which destroys the seeing centers of the brain destroys not only the power to see, but also the ability to remember how things looked. A man whose brain is injured or diseased may be unable to remember any previous experience of sounds, words, or even of nouns or verbs, while memory for all other matter remains intact. All depends on which part of the brain is affected.

This fact, that we do not have in our heads one remembering machine which records all kinds of matter, but have many special memories in nerve centers or tracts scattered widely over the brain, is of weighty importance to the teacher: for as Kay says,[1] "A leading error that arises from regarding the memory as a single faculty is the belief that, in whatever direction we exercise it, we improve it as a whole."

But to exercise a part of our neurones will not improve all of them, any more than exercising one muscle will strengthen all the muscles. A certain mathematician was able to repeat over fifty figures in order after they had been

[1] *Memory: What It Is and How To Improve It*, p. 13.

read off to him, yet could not give even ten letters which he had heard in the same way. If, then, there is so much variation in memory power *within a single sense*, according to the kind of matter presented, we can hardly hope that improvement in eye memory will pass over to ear memory or touch memory or memory in any other sense. It is not surprising that one may have a good memory for names but a poor one for faces, or be able to describe the forms of objects while unable to recall their colors or *vice versa*.

Something, of course, depends on what kinds of memory have been strengthened by practice; but still more depends on which brain fibers have been born strong and which weak.

Essential processes of memory. — From what has been said, it is evident that four processes are involved in a complete act of memory. They are recording, retaining, recalling, and recognizing. If we wish to improve our own memories and those of our pupils, we can do nothing better than to study these processes thoroughly, especially the first.

1. **Efficient recording.** — It is impossible to reproduce a moving picture well with the cinematograph, or sound successfully with the phonograph, unless a high grade film or record has been made. The brain, like these other machines, cannot reproduce what has never been recorded in it. If you would remember well, throw your whole soul into the making of clear, strong impressions. This is exactly what the uninterested, inattentive learner fails to do.

We have found (Chapter V) that experience leaves its marks in the nervous system according to the laws of brain

set, mental set, intensity, frequency, and recency. As we should expect, these are the laws according to which we must imprint on the brain whatever we wish to recall.

Brain set. — A brain is a complex machine composed of many centers, tracts, parts; and each part may be good or bad. Rarely do we find them all good. Now, all these varying parts, when united, make a recording mechanism which is pretty sure to work better on some material than on other. Hence there are large individual variations in power of memory. The musician may find it impossible to remember dates well, while the historian may fail to retain tones. Fortunately, our best memory seems invariably to follow our strongest interest. We should try to discover this and cultivate it, even at the risk of weakness in other directions. In this way we shall succeed better, in the long run, than if we cultivate an all-inclusive, universal kind of memory.

It is a curious fact that our brains can record matter more effectively when it is presented in rhythmic form. Often, when we cannot quite recall a word, especially a name, we can tell how many syllables it has, and where the accent falls. Several times, I have known the names of Julia Ward Howe and Harriet Beecher Stowe to be interchanged by scholars who certainly knew better. One reason for this is evidently the rhythmic similarity.

But so many of our fundamental experiences come by pulses that we should almost expect the brain to work best by spurts. It is easier to learn poetry by heart, than prose. Your pupils can learn their addition tables more easily by saying "three, five, *eight*," "five, six, *eleven*," and so on, than they can if the "swing" is left out. This is one

reason why children so easily fall into " sing song," and why we all tend to slide the accent on to a certain syllable in learning our declensions and conjugations. For the same reason, doggerel verse has been overdone as a means of committing to memory. Such an artificial device should be reserved as a last resort for very important pieces of knowledge which resist more direct attempts at learning. That old arithmetical memory gem which begins, " Thirty days hath September," is commendable doggerel.

These riming aids to memory illustrate a further principle of brain set, that of *unity*. Our brains remember best that which is unified, organized into some kind of *system*, so all nervous and mental currents course in the same direction and reënforce each other, instead of being dissipated in devious ways.[1]

The best kind of *system* for one to use depends on how his brain naturally works best, and the purpose, permanent or transient, for which he is preparing. But since we are constantly trying to adjust ourselves to our environment, a thoughtful mind will do best, in the long swing, by thinking things together in the mind as nature makes them work together in the environment. Lightning causes thunder, heat forms steam, and so on. The result is a thoughtful, logical system, a building every part of which supports all the rest, just such as we find in every science.

Memorizing by wholes, when committing verbatim, probably owes its superiority over the " part " method, to the same principle, that of unity. If we memorize

[1] See the Class Experiment at the close of this chapter, and G. F. Stout's *Groundwork of Psychology*, p. 62; also the author's *Science and Art of Teaching*, p. 96.

prose by paragraphs or poetry by stanzas, these parts remain more fragmentary and less unified than if we commit by repeating the entire piece time after time until we have a good grasp of it *as a whole*. When this is accomplished, it is then best to take the tougher parts separately and master them one by one, by intensive, isolated repetition.

Mental set. — In an office, much business is transacted that never goes on the books. That only is set down which is likely to be wanted for future use. Our minds seem to work similarly: much is experienced which, so far as we can discover, is never recorded.

Further, this is true not of day dreams merely, which may flit through our minds and leave no trace: even serious matter, which costs a struggle to understand it, may not be registered unless we specifically direct our brains to *set it down for future purposes*. The student who has solved a problem, such as an original in geometry, but neglected to make special note of the chief points, the guide posts, in his solution, often finds that it costs him a severe effort to resolve his problem in the classroom.

Whenever we approach any subject of interest, we are mentally set to perceive it, or remember it, or imagine about it (weave it into a story), or think it out, reason about it, or perhaps just to enjoy it, but seldom to do all these things. The child, in his naïve way, wants to perceive and to enjoy. By and by, experience teaches him that it pays, sometimes, deliberately to jot things down in his brain cells for future use.

It is a matter of common observation, which more careful study would probably prove true, that we tend to specialize, either in memory at the expense of reasoning, or in reason-

ing at the expense of memory. If there is such a thing as a mind which can be both storehouse and factory, its kind is rare.

Further, mental set has much to do with the time a record shall last. Commit for a day only, and memory tends to sink with the sun. "Stories and numbers were presented to groups of children. In one case the children were led to expect that their remembrance would be tested on the following day; in another case they were told that the test would be deferred for several weeks. In both cases the test was actually deferred for several weeks; and the results show that the material was much less completely remembered in the case where the learner expected that the test would take place in the near future."[1] A distinguished actor was asked, on a few hours' notice, to take a new part. He soon worked it up, and gave it with precision, but then immediately forgot it. Although he acted the part for several successive days, he found that he was compelled to relearn it, in some measure, for each day. Yet characters which he had mastered more slowly and thoughtfully he could play at any time without previous notice or preparation.[2]

Carpenter (*Mental Physiology*, p. 444) gives a case of a minister, of sound mind and health, who preached the same sermon, accompanied by the same prayer and hymns, on two successive Sundays, to the same congregation. Yet on leaving the pulpit, he had no recollection whatever of having gone through with this very same service a week before.

[1] A. Aall's experiment, as reported in the *Psychological Bulletin*, Vol. X, No. 9, p. 339.

[2] See Kay, *op. cit.*, p. 323.

The first question, when confronted with anything to memorize, is, For what, and for how long, do I want this? The teacher who has not mastered a subject, but has to relearn (not merely review) each lesson in order to teach it, is likely to keep up this wasteful practice year after year.

Intensity. — This includes both interest and attention. A feeling of pleasurable interest is one of the strongest and most necessary factors in all learning. It seems to start a flood of nerve currents in the right direction. Other things being equal, the happiest learners learn fastest. We all tend to remember best what pleases us most.

But if feeling becomes too strong, it may prevent the registering of impressions. A lady, on singing a certain hymn, could not recognize it as one which had been used at her brother's funeral only a short time before, yet so it was. So, the stage-frightened speaker may be unable to tell, when he finishes, what he said on the platform. The fighter, when he recovers from his fighting rage, may be a poor witness as to what took place during the struggle. One trouble in such cases, however, is that the feeling is directed, not toward memorizing, but toward something else. Hence it disturbs or prevents the recording process.

Attention, as we have seen, means force and direction of consciousness. We must put in plenty of powder and shoot straight. There must be, then, first of all, the *will to learn*, closely related to mental set. If a learner remains mentally passive when a list of nonsense syllables is placed before him, he learns but little. And even if he actively attacks them, but with the purpose to *observe*, as how they

are formed, and so on, rather than to remember, he may still see them many times without being able to recite the list.[1]

Direction of consciousness, of all the controllable factors that make a good memory, is probably hardest to manage, but capable of most improvement. Direction includes *concentration*, the centering of the whole heart and soul on the matter in hand. Try to be deaf, blind, dead to all around you, to roommate or classmates, — unconscious even of where you are: *live* and *be*, for the time, the thing you are learning.

With concentration comes *discrimination*. One should first center his attention on the task as a whole, make a kind of snapshot of it in bulk, get a general understanding of it, and then turn the focus of his consciousness from point to point as a panoramic camera sweeps from side to side, taking in a whole landscape bit by bit through its narrow but well focussed lens. Where this process goes, there follows memory. You remember best where you discriminate most accurately.

Intensity takes time. — You must linger over what you wish to remember. The chemicals in the nerve cells are somewhat like those of a camera: they must be given time to work. Too short an exposure means a poor picture. A list of nonsense syllables can be memorized quicker by dwelling a little on each to drive it home, than by running over the list repeatedly at top speed. Here is one reason (but not the only one) why great scholars are so often slow readers, and why our frantic, eleventh hour cramming is likely to be of little avail.

[1] Ladd and Woodworth, *Elements of Physiological Psychology*, p. 582.

Frequency. — As stated before, repetition reduces resistance in the nervous system. Of course, each repetition should be made as intense as possible.

We must apply the law of frequency also in arranging study periods. Experiment proves that frequent, short periods of concentrated study are better than infrequent, long periods. Ten minutes each day will accomplish more than sixty minutes every six days. The figure (Fig. 26)

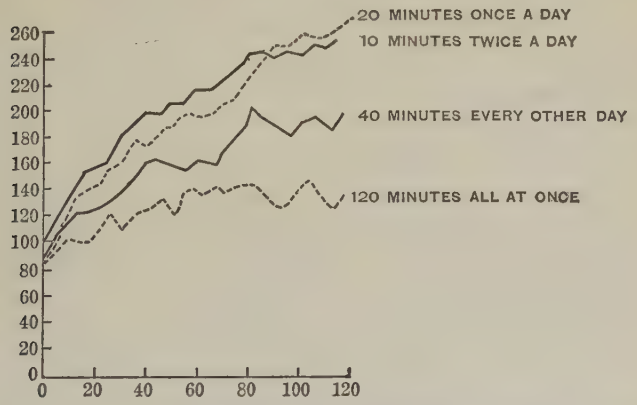

FIG. 26. — Showing improvement in writing numbers for letters, according as the total time of 120 minutes is distributed in four different ways. Based on work of Starch. While this test was not strictly a memory exercise, it illustrates a general law of learning which of course holds true for memory.

shows four rates of improvement due to four different ways of distributing study time.

One reason why the long work period is less profitable is that fatigue soon sets in and diminishes the value of the latter part of the period. Another reason may be that interest flags, and is renewed with rest. Further, as we

shall see, brain fibers develop and learning increases even during sleep.

Just how short and frequent the study periods should be made probably depends on the age and ability of the pupil and the kind of material to be memorized. Very likely this will have to be worked out by experiment for various types of pupil and of lesson. But we can all safely make use of the general principle.

In repeating and reviewing, use *ideas* as much as possible. That is, struggle to recall without re-perceiving what is to be learned. Such effort has an effect which may be compared to the developing and fixing process in photography.

Recency. — We all know how our brain records fade with time, how we catch a last glance at the lesson to be recited, and rehearse our parts shortly before exhibition. How rapidly or slowly this fading goes on depends on how thoroughly the matter has been learned.

2. **Efficient retaining.** — Where are ideas when they are not being remembered? Where are the moving pictures when they are not on the screen, or the tones of the phonograph when the record lies in the cabinet? Between the recording of an experience and its reproduction, it apparently exists only as physiological traces in the brain cells.

In popular speech, much is made of the subconscious, where our ideas, *as ideas*, as fragments of consciousness, are supposed to dwell when not in use. But the subconscious, so far as we can see, is nothing but brain structure and a certain kind of brain process. Of the many picture records on the film, only one at a time is

projected; of the many sound records on the disk, but one at a time is intoned; of the many idea records in the brain, but one at a time is "played," energized. Of course, we must not say that the brain works just like a phonograph or a cinematograph, but the similarity is close enough for illustrative purposes.

Our first duty, then, is to keep the brain in fine physical condition, nourished by a strong, pure blood stream, rested by sleep, and toned up by recreation that really re-creates and does not burn out and exhaust. Wholesome brain exercise, too, is needed. Muscles improve with right use, and very likely neurones do, too. Everything we know about them would lead us to expect such improvement, both in their general condition, and also in an increasing fineness of fiber and nicety of connection with increasing discrimination and accuracy of reaction.[1]

Such growth and improvement go on unconsciously. Owing to these progressive brain changes, you find that you can remember easily, in the morning, what you could barely rehearse the night before. But if, having memorized a lesson, you go on trying to stamp more records on the same neurones, your memory will be less effective. Two exposures of the same photographic plate may spoil both pictures. The learner should rest for a few minutes after each study period, or, if he is still fresh, turn to a different kind of learning and so use a new set of neurones.

Finally, one should not disturb his brain records by worry, or by fear of forgetting. "Learn to trust the memory," says Kay, "and, in order to trust it, strive to

[1] See Ladd and Woodworth, *Elements of Physiological Psychology*, p. 616.

make it worthy to be trusted. It grows in trustworthiness by being trusted." [1]

3. **Effective recalling.** — In a business office, when we have made a good record of anything, our next concern is to file it so we can find it. This is true also in a business-like brain. When we forget, the brain record is not, as a rule, obliterated; but we cannot turn to it. We are like those fussy people who don't know where they have put things.

Let us notice that (practically) everything comes into the mind following something else, which has aroused it. So, *August* may be followed by *Augustus Cæsar*, and this by *Julius*. The brain cells seem to empty their contents like the cartridges of a machine gun, each charge setting off the next. This gives another reason why it is better to memorize a piece by complete readings rather than by lines, paragraphs, or stanzas. The complete readings leave no breaks between records.

Assuming that we have well-impressed records, *the whole art of effective recall depends on getting the right records together*, so that each, when energized, will set off the next. Take a common case. Why does one tie a string on his finger to make him remember some commission he is charged with, such as a purchase? Because, first, by this unusual performance, the purchase is intensely impressed upon his mind and associated with the string. And secondly, since the hands (and so the string) are sure to be seen frequently, the string-record will not only rouse the purchase-record frequently, but will be very sure to start

[1] *Op. cit.*, p. 323.

the purchase-cell into action as one approaches the proper place for making the purchase.

Let us refer again to our five familiar laws.

Brain set. — This reveals two ways of organizing memory material, the *naïve* and the *reflective*. The most naïve way of all is to let events organize themselves as they occur, form whatever accidental associations they will. One stage of progress beyond this comes the arrangement of brain records in chronological order; in other words, recording and recalling everything in the order in which it was experienced originally. He of naïve, chronological memory is likely to unload upon you an endless cargo of details, telling everything " just as it happened." Ask him a question that requires thought and you " throw him off the track." His brain record, like a phonograph record, must be played from start to finish.

One who has an unusually strong verbatim memory often finds it an inconvenience to him. A well-known Englishman who could repeat a whole Act of Parliament, or other similar document, after a single reading, was heard to declare that this very power often gave him much trouble; for if he wanted to summon into mind any particular point of what he had read, his only way to do it was to repeat to himself the whole piece from the beginning (like a child running up the multiplication table) until he reached the point desired. As one would expect, this gentleman could learn languages with unusual ease.[1]

Reflective memory, called logical memory, is selective, a card-index kind of memory. Brain records are filed according to *purpose*, the purpose for which they are likely

[1] See William B. Carpenter's *Mental Physiology*, p. 451.

to be used, in a definite system. For example: Edison says that his life has been free from temptation. The preacher notes that here is a man who is not tempted in the usual way; he will recall this when next he preaches about Temptation. The psychologist observes that here is an inhibition, by a great purpose, of all unworthy ideas: it will flash into his mind when he discusses the Psychology of the Moral Life. The vocational adviser sets it down in his mind as an example of the value of Finding the Right Vocation; it will serve as illustration in his next lecture on that subject.

A very effective way of recalling what is forgotten is to charge your brain to reproduce it, and then go on, thinking no more about it. The lost item may pop into your mind sooner than it would had you kept goading your memory to find it. Such is the power of subconscious cerebration.

Mental set. — We have many mental files, so to speak, and can turn to any one of them at will. We can set ourselves to recall the facts of any branch we have studied, shutting out the facts of other branches, as a musician sets himself to play in a certain key, forgetful of all other keys. Set yourself to recollect your childhood and you will resurrect much from the buried past.

It is wise to maintain the same mental set in recording that is likely to be present when recalling. It is hard to give, in public, a speech memorized in private. Memorize in the presence of an imaginary audience.

Intensity. — We are often exhorted to form as *many* associations as possible with that which we wish to remember, and so make many brain paths to it. But these associations should be *strong* if they are to be useful.

One highway is worth many obscure and swampy roads. It aids both recording and recalling if we fix our attention on the most striking features of our memory task. The most striking features are those which we experience most intensely: the nose of one face fixes it for us, the eyes of another, the chin of another, and so on.

Frequency. — The art of remembering is the art of thinking, says James. The merchant remembers prices, the athlete, scores and records, the chemist, formulas, because each *thinks* so often over his pet subject that he weaves his facts into a perfect tissue of strong associations.

Recency. — Sometimes, the best cue for recall lies in repeating our recent train of associations, " beginning over," as the child does in reciting. So, one may often find a mislaid article by going to the place where he last remembers having it, and trying to repeat his course, following up the most likely suggestions.

4. **Efficient recognizing.** — If you meet a man on the street, you may know it is Davis, Jones, or Smith, yet not know which name to use. You have recorded his name, retained it, and recalled it, but fail to recognize which, among others, it is. Again, you may accord recognition to some name or other item as that which you wish to recall when it really is not. Some of the reasons for faulty recognition appear below.

False remembering. — So far, we have spoken of ideas as if they were rather mechanically recorded, and reproduced without change. But ideas are not mummies: they may grow and change, like your old acquaintances, almost beyond recognition. Memory is seldom a clear-cut record of the past, a photograph unfaded. Much is

lost, for it is impossible to cram the whole past into the present. Memory is more like those old manuscripts which, having been used over and over, show fragments and suggestions of the inscriptions made at various times. And in the case of memory, such a combination sometimes makes a record really false.

Meumann [1] gives various types of false memory, of which the following are most important: (1) There are holes, blank places, in our memory. (2) These blanks are filled by what is *commonly* true in such cases, or by what we judge *must* have been true. " Rodenwaldt investigated the memories of a number of adults, employing as his material a picture of an infant in a cradle. The majority of his observers ' remembered ' that the color of the cradle was brown although it really was a conspicuous blue in the picture." [2] The cradles they had seen most were brown. (3) Ideas, especially similar ideas, such as similar pictures by two artists, fuse, grow together. (4) Our feelings cause certain ideas to stand out prominently, others to recede, so distorting the memory picture. As people prophesy what they wish to come to pass, so they " remember " what they wish had come to pass.

Forgetting. — There is a theory to the effect that nothing once learned is ever entirely forgotten: *apparent* forgetting is due to our inability to get at the right record in the brain. Fatigue often causes this. Cases are known where travelers, fatigued with the journey, have even " forgotten " a foreign language which they could speak well when fresh. Botanists, after a long tramp, sometimes find themselves unable

[1] E. Meumann, *The Psychology of Learning* (Baird's translation), pp. 8–11.
[2] Meumann, *op. cit.*, p. 8.

to recall the names of common plants. Teachers, when fatigued, may find it hard to call the names of their pupils for recitation.

Certainly, our "forgotten" knowledge leaves us with a brain different from one which has never learned. Brain traces remain which change the course of future nerve currents, influence our judgment, and help to direct our future feeling, the course of our "common sense," and our conduct.

One of the most practical truths for the teacher is that (putting it roughly) *learning lasts in proportion to its thoroughness*. If a list of nonsense syllables is learned so that it can just be repeated once, it is about half forgotten within the first half hour; but if studied until two perfect recitations can be given, it is six days before the list is half unlearned. Retention is here measured by time saved in relearning. Material that has meaning is more easily learned and better retained than nonsense syllables. In either case, forgetting is more rapid at first, slower afterward. It can be further slowed down by relearning — can be retarded, in fact, until it appears to cease altogether. In other words, one can learn and relearn matter so thoroughly that, without further effort of any kind, it is his for life.

CLASS EXERCISES

I

Let each of the following lists be pronounced to the class at the rate of about one per second, after which each will write as many syllables or words as he can recall.

1. mol, pof, lez, gir, reb, lem, zat, neb, tid, vib, kas, dov.
2. bat, man, top, dog, sweet, cup, dry, bag, dot, fleet, Jack, horse.

3. if, you, would, make, all, men, your, friends, be, kind, to, them.

Compute the average for the class in each case, and explain the results. Does this throw any light on school work?

II

Plan an experiment to find, in a class of school children, the character and amount of individual differences in power to memorize. What do such differences have to do with teaching?

FOR FURTHER STUDY

1. Crimes are sometimes re-enacted in the court room. What effect would this have on memory? Why?

2. Why is one ever compelled to say, "Did this really happen, or did I dream it?"

3. Draw a figure, after the manner of Figure 26, to show that a repeated experience may be distinguished by its lack of the feeling of strangeness.

4. Write or tell of some of the adventures which you think would befall "A Man Without a Memory."

5. Authors sometimes feel that they themselves have done what they have made their characters do in books. Why is this?

6. Why is the gum-chewing office girl, who drops her work at the door sill, likely to be forgetful?

7. What kind of memory do you expect from the pupil who restlessly watches the clock? Why?

8. Make a list of important rules for recording and recalling.

9. The student who records everything in his notebook, quite frequently has to go to his notebook for facts which he should remember. Why is this?

10. Why are outlines an aid to memory, as the outline of a chapter in psychology? If a student disliked such outlines, should you expect him to have a chronological or a logical memory? (See page 153.)

11. A station agent found that he could remember much better when in his office than when out of it, the hours when his trains came and went. Why should this be?

Can a student take an examination as successfully in a strange place as in a familiar one? Why?

12. Devise an experiment to show whether slow or fast repetitions are better in learning.

13. Why are similar things, as similar words (like *a*ffect and *e*ffect), so hard to remember distinctly? How can we aid children in such cases?

14. If children commit to memory many gems of poetry, will this help them greatly in memorizing the multiplication table and the dates of history?

15. Describe any tricks of memory which you have found to work well.

16. It is commonly said that history and literature strengthen "the memory." What do you think of the statement? How could the question be decided experimentally?

17. Make an outline of this chapter.

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CHAPTER X

ANALYZING AND ASSOCIATING

Exercise. — Turn to dictionary or encyclopedia and analyze the flags of several of the leading nations. Note forms, colors, symbols, relation of parts. Which of these forms, colors, etc., are found most frequently?

Now suppose that all the nations of the earth have united under one government. Mentally construct, and then draw and color, a flag or other symbol which you regard as suitable for this union. Give reasons for your choice of form, color, etc.

We have studied how experience is gathered, recorded, and reproduced. Now, as in a factory, the raw material is often cut into parts, so our mental materials may be taken apart, analyzed; and as the factory fashions new forms, so the brain makes new combinations, synthesizes, associates. Let us study these processes of analyzing and associating.

Adaptation to environment demands discrimination. — This world is full of things that are different from each other, and animals must act differently toward them or suffer serious consequences. The sheep that goes out in the springtime and eats green things indiscriminately, laurel leaves included, soon stops eating anything — at least till it recovers. Even the amœba extrudes the bit of stone which it happens to inclose, but hugs its morsel of vegetable matter.

The world of the young child must be somewhat like that of one who is just recovering consciousness after a

blow or an anæsthetic, or who wakes in totally strange surroundings; or like the visual experience of one who has had " drops " in his eyes, or puts on glasses that blur everything. The stream of experience is one great drift of fog. But as the baby whacks his toes and his toys indiscriminately, he feels a " shock of difference," as James calls it. Tennyson, in his *In Memoriam*, has expressed very beautifully the infant's gradual discrimination between the *me* and the *not-me*.

" The baby new to earth and sky,
What time his tender palm is prest
Against the circle of the breast,
Has never thought that ' this is I: '

But as he grows he gathers much,
And learns the use of ' I,' and ' me,'
And finds ' I am not what I see,
And other than the things I touch.' "

These shocks of difference between various experiences become more numerous as he pursues his career of getting what he wants, until at last the world is found to be " full of a number of things," all of which must be treated differently if he would work his will on them: for example, he no longer puts *everything* into his mouth. And before many years, if offered his choice between a five-dollar gold piece and a new penny that looks much like it, he will discriminate nicely between them.

Discrimination and analysis. — These two words are closely related in meaning. To discriminate is to experience a difference, as when we see a difference between checkers and chess. To analyze anything is to discriminate (among)

all its parts, as when we discover that a checkerboard is composed of sixty-four squares, half one color, half another; or take apart our idea of *weather*, or of *man*, to find what it necessarily contains.

The *relation* of the parts is important, too. We must discriminate different orders of arrangement. The squares on the checkerboard must be arranged in a certain way, not *any* way. The letters *a*, *t*, and *r* may make *art*, *rat*, or *tar*. But this leads us from analysis into synthesis.

Practical importance of discrimination and analysis. — Whether or not one discovers differences and acts on them is often a life-and-death matter. The electrician turns the wrong switch or touches the wrong wire; toadstools are gathered for mushrooms; the patient doses himself from the wrong bottle; shiploads of "fool's gold" are mined and sent across sea; the engineer fails to distinguish signals and his train is wrecked.

Your pupils will long confuse *to*, *too*, and *two*, yellow and orange, blue and green, the plus and times signs in arithmetic, certain notes of the scale, the words affect and effect, and a lengthy list of other similars. Every word misspelled or mispronounced, every problem mis-solved, every *f* written with its lower part twisted back into a *j*, every subject and verb unequally yoked together, suggests a neglect of discrimination and analysis.

Children may speak of a "violet man," meaning a violent man, and of the "smell of violents," or of "violence." Merchandise becomes "merchant dyes," or "merchant dies." A fourteen-year-old spoke repeatedly of a "signal man," meaning a single, unmarried man. A seven-year-old, on hearing some one say, "Poison will paralyze," re-

marked, " That's heaven." Inquiry showed that he had failed to discriminate between *paralyze* and *paradise*. After I had demonstrated the Edlemann-Galton whistle before a psychology class, several students wrote " Alderman Galton's whistle." I ought to have written the name on the board, at the same time calling their attention to the pronunciation.

It is easy to find physicians who can administer medicine when the disease is recognized; but the power to diagnose a case, to analyze symptoms, and discover what disease actually is present — that is rare. So everywhere: the lawyer must analyze cases; the merchant, the wants of his customers; the farmer is learning to analyze his soils, his markets, and the requirements of various kinds of plant life. " I know a hawk from a handsaw," says Hamlet. So Shakespeare reminds us that the power to discriminate common things is a frequent test of sanity and common sense.

Education is largely a process of learning to analyze and discriminate. Every verb in the Turkish language is capable of taking twenty-five thousand different forms, and some other languages are almost as bad. All must be discriminated. Bacon's essay on " Gardens " mentions well toward a hundred different plants, classified according to the month in which they flower in England. And he was not primarily a botanist. How many colors there are depends on how well educated you are in color: some see four or five, some a hundred, and some see thousands.

The law of analysis. — In the first place, notice that analysis and discrimination always go back to *sensory* discrimination, the shocks of difference we get as we use our

sense organs on the outside world; as when we discriminate between an impression of yellow and one of orange. In faces, trees, houses, forms of government, etc., we can usually discover some large *bulk* of difference. One house has a tower which the other lacks. But "in the last analysis," we find that our power to analyze, to discover differences, goes back to sensory discrimination, our power to discriminate between impressions. The difference between a red, white, and blue flag and a red, white, and green one of the same pattern, is just the difference between blue and green. Our pupils should have a wealth of practice in sensory discrimination.

Now for the law: *Whatever is analyzed out of a complex must be thrown up in relief.* Some way must be provided to make it impress its separate pattern on the brain. We might almost state the law: *Whatever is analyzed out of a complex must have been experienced alone.* But nothing is ever experienced absolutely alone: there is always something in the background. "Alone" would have to mean "apart from, or contrasted with, that which we are now trying to analyze it away from."

You could never find the face hidden in the tree of a puzzle picture if you had never seen a face apart from that picture. Such faces would have no meaning for you. "Sweet" and "lemon" would not be analyzed from lemonade if the analyzer had not tasted them elsewhere, or in varying proportions. Notes cannot be recognized in a chord unless they have been heard out of the chord, or accented in the chord. Hear the violin alone, and then you can follow it when the full orchestra is playing. If you want your pupils to sing the alto and soprano

well in harmony, let them hear and sing these parts separately.

When a complex, such as the taste of lemonade, or a chord of music, is experienced, a certain group of brain fibers is brought into play, *as a unit*. Now, let a part of the complex, such as the taste of lemon, or a single note, be separately sensed: almost certainly, a part only of the fibers previously used are thrilled this time, hence have been impressed more *frequently*, with a different *mental set*, and (since attention is centered on the isolated experience) probably with greater *intensity*. Consequently, when the complex is again experienced, this part which has been isolated can again be isolated at will. The situation is somewhat like learning to control a single finger, and later, to distinguish its action even when all the fingers are acting together.

If we could watch the brain of one who keeps making discriminations, we should no doubt observe that it grew finer-grained, so to speak, as fibers that had formerly acted as a unit learned to function individually. The brain of the boor and the clodhopper never acquire this refinement of response even to ordinary and oft-repeated situations.

Free images and free ideas. — If John Smith is found, from time to time, with many different groups of companions, we come to feel that he is free, and need not depend on any particular group to support his personality. So, if we analyze an image or an idea out of different groups of associates, it becomes free, and has a name and nature of its own, as does the image of red or the idea of liberty. Such free units are of great value, serving the purpose of

portable blocks which can be used over and over in our mental structures. The loftier the intellect, the more use it is likely to make of such free ideas.

But the average man does not ordinarily set himself to quarry out a stock of free ideas in any deliberate way. The process goes on almost accidentally. Let us see how a child gets his free image of *red*. He sees a red flower, a red book, a red sunset (see Fig. 27). At first he may regard the word red as the name of a flower; but as he finds this word passed around to books, sunsets, cheeks, and so on, both the color and the word that goes with it are at length "stamped" into his brain cells and come to have an independent, free existence of their own.

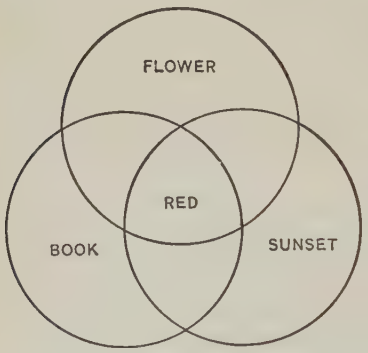

FIG. 27. — Showing how the image of red becomes free.

Thinking, and so progress, are often impeded by reluctance or inability to separate ideas long tied together, and so make *free* ideas of them. Many find it hard to separate the ideas of smoker, soldier, voter, from the idea of man, and attach them to the idea of woman. *Wings* and *bird* are so commonly tied that it is difficult for some to believe that a bat is not a bird. Certain students can hardly separate *warmth* and *impurity* when thinking of air. *Metal* and *heaviness* were assumed inseparable until a light metal was discovered. We should probably hasten our progress considerably if we would tear our old ideas

well to pieces, *mentally* construct what we want, and then set to work to build it *objectively*.

No one knows as yet, — and we can find out by trial only, — how early in a child's life we should introduce regular exercises in discrimination and analysis, or how extensively they should be carried on, or the best practical use to make of the ideas that are set free. But there is good reason to believe that we are underworking in this direction. Here is a place where education can sharpen the wits much more effectively than ordinary contact with the environment would whet them. If all red objects were round and all round objects were red, it would never enter the head of any ordinary person that redness and roundness could be separated. Yet (as appears above) the commonplace environment leaves many ideas joined together which ought to be put asunder.

Even in the kindergarten, we can place before the children objects which vary much in shape, size, color, material, use, and so on, and have our playful discriminators group and regroup them so as to make first one idea and then another stand out in relief. For example, let us first have all square objects piled together; then all red ones; all that are made of wood, or of cloth, or of metal; all that are good to eat, or that can be cut with a knife, or that will roll. As these successive experiences crisscross each other, they cut the unessential, accidental ties that have held ideas together in mental clumps, and leave them as free objects of attention, ready to combine in ways that are new, interesting, and useful.[1]

The greater the variety and contrast among the different

[1] See p. 120 of C. Lloyd Morgan's *Psychology for Teachers*.

situations in which any experience appears, the sooner will it disengage itself and become free. If we teach the noun by calling attention to subject nouns only, the pupil may fail to analyze out the noun in a new position, as in the predicate.

Culture of discrimination and analysis. — Two facts stand out here with great importance.

The first is that discrimination (and hence some power of analysis) *can be cultivated*. Classic cases are those of the blind Laura Bridgman, who recognized, by the " feel " of the hand, a person with whom she had shaken hands a year before; of the blind Julia Brace, whose sense of smell enabled her, it is said, to sort the clothing of the many inmates of the Hartford Asylum, as it came from the laundry; of wine-tasters who can tell by taste alone which vineyard produced any choice wine, and in what year; and of the artists, dyers, and temperers of metals, who know when they have produced exactly the desired one of a whole range of a thousand colors. The psychological laboratory tells the same story: for example, the power to discriminate two compass points as two, when touched to the skin at successively decreasing distances, has been known to improve, in a few hours, to twice the original.

Secondly: To cultivate analysis, cultivate attention. Many of our failures to discriminate go back to the blunderous teaching of our early days. Let a child be confused in his first sensations from an object and ambiguous in his first reactions toward it, and he may live on to the end of his days with the feeling that there is something hopelessly uncanny and unmanageable about it. A brilliant teacher of my acquaintance, confronted by the problem

of two feet and two overshoes to put on them, has for years picked up an overshoe, started to put it on the wrong foot, and then corrected the movement.

Of course, native brain set for the task attempted is always necessary. The teacher referred to is ambidextrous, and may be so ambipedrous by birth as to sense less difference between his two feet than most of us experience with ours. We are all likely to remain poor discriminators in some department. One cannot tell the common colors apart; another can see no difference between similar sounds, or even words; perhaps we get "mixed" easily in names and faces. To some, all foreigners look alike; and it is said that old bachelors can see so little difference in babies that they would as soon have one as another.

But pretty certainly most of our failures to discriminate result from our laziness or indifference. The achievements of the blind, so often exploited, can be duplicated by any one who will work with as patient and prolonged attention as the accomplished blind have given. Focus your consciousness on point after point of any object, physical or mental, and its constituent parts will stand out. Herein lies one great value of drawing, making, acting, translating, of all expressive work: success demands this very point-to-point concentration.

Having considered the analysis of the contents of our minds, let us turn to their synthesis, to association.

What is association? — Association is the grouping of our mental materials. If we use the term very broadly, it includes all possible combinations of mental elements. For example, when you perceive a rainbow, the perception consists of a number of impressions already grouped, or

associated. But they are grouped in your mind because their *stimuli* are grouped in the outside world.

The word *association* applies more particularly to those collections or assemblages of mental material which did not enter the mind as such, but are grouped in the mind itself, by the brain itself, rather than by the arrangement of stimuli and the action of sense organs. Imagine a green moon in the sky. You never saw that: it is a brain-built association, composed of old materials, analyzed apart and then recombined.

How associating goes on. — You can easily discover how the course of associations runs, by playing the part of psy-

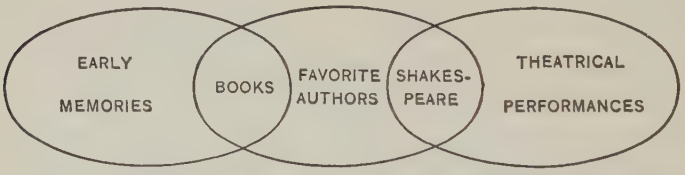

FIG. 28. — Showing association due to overlapping fields of experience.

chological spy at any conversation. You discover that our experience lies in *fields*, more or less sharply separated, but often overlapping, or with the fences down, so we can ramble from one to another. So (as Fig. 28 shows), we may talk of early memories, including memories of books; but " books " also lies in the field of favorite authors, which may suggest Shakespeare, and Shakespeare, perhaps, reminds us of the theater, and so of the play to-night. So we start with the memory of our first day at school and end with the question of going to the theater to-night!

The law of association. — We often appear, as in the example above, to move our mental materials in *bulk:* we

mingle whole landscapes of perceptions and flying squadrons of ideas in a moment. But these complexes are made of mental elements, sensations, and affections, which, lying in two overlapping fields of experience, connect the two. So, when I was introduced to Mr. Marti, I remembered his name by thinking of smarty (though he is not one, by any means). How is this? "Marti" and "marty" are almost identical in sound. "Smarty" is a familiar yet novel word, easy to recall, and by its parts which are common to the two fields of experience, it enables me to pass to the desired name. Similarly, a strawberry may remind one of other red things, as a sunset, this of a sunrise, and the sunrise of a boy getting up. A word often reminds you of some riming word — you can easily understand why.

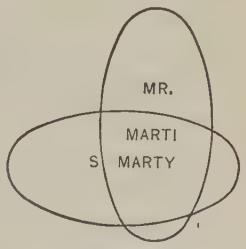

FIG. 29.

But why should a strawberry suggest a sunset rather than a red nose, or any of many other things? *Those elements are associated whose records lie along the line of least resistance in the brain.*

From the time of Aristotle, it has been customary to explain association as due to (1) similarity, (2) contrast, and (3) contiguity (that is, occurrence together) in time or space. So, a tall man reminds us (1) of another tall man, or (2) the opposite, a very short man, or (3) something which occurred at the time when, or in the place where, we experienced the tall man. These three laws have practical value in everyday life. For a discussion of them, and the reasons for replacing them with a single compre-

hensive law, see Titchener's *A Beginner's Psychology*, Ch. VI.

Two persons who look alike remind you of each other largely because they impress the same neighboring neurones. In one of my classes is a pair of twins so much alike that the only way I can tell Mary from Margaret is by discriminating their shades of hair, which differ slightly. Probably I shall never think of one without recalling the other also.

Now, does the law stated above mean anything definite? Yes: for we do know something about the way records lie in the brain, and the probable paths of least resistance. Further, these paths are determined by the laws you already know, which are here repeated.

Laws of brain set, mental set, intensity, frequency, and recency. — Whether a record is made in any part of the brain depends on (1) the neurones in that part, and (2) the force that acts on them.

(1) The born poet has a brain of such constitution that it favors poetic associations. He is likely to form them in overplus abundance, sending them up the chimney with the smoke, as Tennyson did. A favorable mental set, such as the poet's hour of inspiration, seems to charge these neurones and put them " at attention," so to speak, ready for a certain kind of action.

(2) An impressing force of any kind may vary in intensity, frequency of impact, and the recency with which it has cleared the neural channels. The subjects about which the poet versifies are chosen for him by the comparative intensity, frequency, and recency of his various experiences. His life lies in his poetry voluntarily or non-voluntarily.

The course of our associations has well been likened to the spreading of a fire in a mass of fuel whose parts inflame with different degrees of difficulty.[1] The brain with its graded resistances and preferred paths, is the fuel; the power of the associative flame is conditioned by the factors of intensity, frequency, and recency of the experiences now present.

Value of association. — Association is the putting together of our mental parts to make, at last, one whole mind. Without this process, a mind would be like a machine whose pieces are all present, perhaps, but not assembled in working order.

Consider the case of Jenny Morgan, a young woman who, blind from birth, received sight by an operation. Using the newly acquired sense of sight only, she could report correctly on the shape and color of any object, but could not say what the object actually was until she touched it. For example, if a pair of scissors was placed before her, she would describe, from sight alone, their shape, color, and metallic appearance; but she was unable to name them until she had touched them, when the wanting name would spring immediately to her lips and she would laugh at what she called her stupidity in not having recognized them before. But such an educative experience as this, that is, associating the familiar perception by touch, the new perception by sight, and the name of the object, left her able thereafter always to recognize the object without touching it.[2]

The child, like many adults, lives largely in one field of

[1] See G. F. Stout, *The Groundwork of Psychology*, p. 117.

[2] See William B. Carpenter's *Principles of Mental Physiology*, p. 189.

experience at a time. Were it not for association, these separate fields would remain almost as unconnected as if they were registered in different brains. When Franklin first associated lightning and electricity, the wisest of his time could see no wisdom in such thinking. How often the learner fails to find any connection between his schoolroom knowledge and the life outside! In church, we may all accept and rejoice in important truths which seldom occur to us at any other time, and so are seldom applied. The student versed in psychology may so "forget it all" when he begins to teach that his psychology is never thought of as having anything to do with his schoolroom practice.

One of the chief differences between the educated and the uneducated is that he of disciplined intellect has learned to weave all his threads of knowledge into one systematic web. The world outside is of many parts, joined to make one: our many-parted mental world must be associated into a similar unity.

Association gives meaning. — What does it mean to have a meaning? To have a meaning is to have associations. When some one speaks to you in an unknown tongue, his words have "no meaning" because they arouse in your mind no associations, or next to none. The sounds of his words stand alone. Without associations, nothing would have a meaning.

On the other hand, a familiar word, when pronounced to you, at once becomes a nucleus round which are grouped many images and perhaps affections. Like a person in a community, it has significance in proportion to the kind and number of associates it can attract.

Individual differences in association. — We observe in each other, and shall find among our pupils, great differences in associative power. First, there is a difference in *speed*. In the Binet tests for intelligence (Stanford revision), one who is ten years of age mentally is expected to give sixty words in three minutes. Some subjects respond with a quick-flowing stream of many more than sixty, while the utterances of others are few and far between. But the very fastest associators are not necessarily the very brightest.

There is also a vast difference in *range* of association, one sticking to a narrow track of ideas, another rambling world wide, as appears so strikingly in conversation. Then there are the *tight* and the *loose* associators, or as we may call them, the realistic and the imaginative. Some of the first cannot bear to read a book of fiction, and object to fairy stories in home or school; for such stories are "not real." The second, the imaginative kind, may see all life as a fairy story with highly romantic possibilities shining out everywhere. And if he can not make these things actually come to pass in the outside world, he can make them real enough to enjoy in the world of his mind, at least.

Finally, associations differ greatly in *value*. A single idea that gives us control over some power of nature or human nature may be worth more than diamonds. In fact, ideas much resemble diamonds in that it is often difficult to tell the difference between the valuable and the valueless. It is especially hard for children to judge whether their ideas are worthy or worthless. Ordinarily, we must beware of inhibiting the flow, and tolerate abundance of whatever grade.

Subconscious cerebration. — Cerebration means action of the cerebrum. Subconscious means not-conscious-but-like-conscious. No one knows the precise difference between conscious cerebration and unconscious cerebration. The results are often much the same.

Nearly every one knows of some case in which a problem has been solved, an invention made, or a piece of composition executed, during sleep, perhaps dreamless sleep. Also, many associations, once conscious but later forgotten, leave their records in the brain in such a way as to exercise a strong influence on conscious life. So, while it is well to be able to give " a reason of the hope that is in you," your hope *may* be well founded even when you can give no reason except " I feel." Herein lies the value of our forgotten knowledge: it is like the foundation of a building, unseen but supporting that which is visible. Here, too, is the basis of many preferences and prejudices.

Subconscious cerebration explains, also, many ideas which arise in our minds, apparently unconnected with anything immediately preceding. Our brain currents seem to sink sometimes into the subconscious, like the rivers which pass underground, thence reappearing at a new point.

CLASS EXERCISE

The purpose of the exercise is to study the process of analyzing mental material and associating its parts in a new way.

Let the instructor read a limited number (say three or four) selections from Æsop's Fables, Mother Goose, or other similar literature. After the reading of a selection, each will record the characters that appear in it, and make a brief analysis of each one, noting his chief characteristics.

Then make a new group of characters, selecting them from the list already formed. If the course of the story seems to demand it, new characters also may be introduced. Construct a new story of the same general kind as those read, permitting the characters to behave " just as they want to " when they find themselves in each other's company. It is not necessary that the story have a moral.

This may be followed by discussion, including introspective explanations of how the various results came about.

FOR FURTHER STUDY

1. The definition, " A point denotes position without length, breadth, or thickness," was rendered by one child, after concert drill, " A point denotes a physician without strength, health, or sickness." How can we secure discrimination even in concert work?

2. Compare, as best you can, the dog, horse, and other animals with man, considering the following points: (1) sense organs, (2) perceptions, (3) memory, (4) mental analysis, mental synthesis. Similarly, compare children with adults.

3. Marksmen are found to improve most rapidly when they are told where their missing shots strike. Why is this?

4. Trace the relation of analysis to the laws of brain set, mental set, intensity, frequency, and recency.

5. Tell what you would do to develop in a child's mind a free idea of " square "; of " value "; of " good."

6. Mature students are sometimes found to make no distinction between " perpendicular " and " vertical." Why do you think this is? How would you correct it?

7. If you wished to make sure that a boy had discriminated carefully all parts of a kite, should you prefer to have him look at a kite, draw a kite, or make and fly a kite? Why?

8. What value is there in composition work, from the standpoint of discrimination and analysis?

9. A pupil insisted that in the sentence, " *Night Thoughts* is a good book," the verb should be plural. What was his trouble?

10. Make a list of important discriminations in arithmetic, geography, spelling, language, or grammar.

11. What should you expect the word " case " to call up in the mind of a lawyer? of a physician? of a watchmaker? of a student in a co-educational school? Why?

12. Show, by illustration, that the laws of similarity, contrast, and contiguity, all depend on the fact that there are identical elements which lie in two fields of experience and so enable us to pass from one to the other.

13. In teaching Laura Bridgman (a blind deaf-mute), the first experiments " were made by pasting upon several common articles, such as keys, spoons, knives, and the like, little paper labels on which the name of the article had been printed in raised letters." Show the value of this.

Would you advise pasting on articles their names in order to teach a child the words of his own or a foreign tongue?

14. A sixth-grade boy, on being asked where one could find a rectangle, said " In the arithmetic." When told to find one outside the arithmetic, he began to search among the clouds and trees, although he was sitting on a rectangular porch with his feet on a rectangular stone, near rectangular doors and windows. What was the matter? How would you teach him?

15. Start a conversation with a friend (or friends). See if you can lead it from topic to topic by suggesting appropriate associations. Afterward, try to explain what happened.

16. A bright high-school boy, with normal sense organs, was working on a railroad section, on which, he had been told, no trains were running that day. As he was walking along the track, a locomotive ran up behind him and killed him. What directions (that is, what mental set) could have been given him that would have prevented this?

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CHAPTER XI

IMAGERY AND IMAGINING

Exercise. — Print your name in capitals. Let the paper lie, but imagine you are holding it before a mirror, right side up. Locate mentally the reflection of the first letter of the name; of the last letter. In imagination, trace some (perhaps all) the letters, moving your hand if necessary. Now, print on paper the reflection of your name, as you imagine it. Test your drawing by comparing it with the actual reflection in a mirror.

Write an introspective account of what passed through your mind during the whole process.

We have seen how experience is gathered, recorded and reproduced, analyzed, synthesized. In this chapter and the next, we shall study two especially interesting and valuable kinds of analyzing and synthesizing, the kind called Imagining, and the kind called Thinking. To understand these, we must know more of images and how they behave: therefore, Imagery first.

From impression to image. — As Titchener points out,[1] " there is no department of sense in which sensation stops entirely when its stimulus is removed." Sensation may persist as a " positive after-image," that is, a continuation of the original impression, as when a look at the sun leaves its orb " in your eye " for a time; or the persisting sensation may take the form of a " negative after-image," as when a stare of fifteen seconds at red is followed by bluish green; or the stimulus may persist in the brain rather than in the sense organ, resulting in a " memory after-

[1] *A Beginner's Psychology*, p. 74.

image," such as some children have for several seconds when a word at which they have been looking hard, is suddenly erased from the blackboard, or when, after the teacher has ceased dictating a sentence, they still " hear " her voice and write accordingly. " Recurrent images " are such as those which, forming tunes, jingles, and the like, keep on recurring in spite of us, perhaps for a whole day.

So we pass, by gradual steps, from the impression, which points us directly to the objective thing that started it, to the common type of image which composes our day dreams, and which seems to have been naturalized into purely subjective citizenship.

Contrast of impression and image. — As an image is simply a revived impression, we should expect the original and its resurrected ghost to be as much alike as a sound and its echo. And so they are: These two forms of the same sensation are alike in *quality:* their chief difference is one of *intensity.* Because of this lack of intensity, an idea, which is composed of images, is less clear than a perception, which is composed of impressions. Observe that when an impression is produced, its brain tract is stimulated from without the brain; but when the corresponding image appears, the same brain tract (probably) is stimulated by a current usually weaker from a neighboring neurone. Let our images become sufficiently intense, as they sometimes do, and we mistake them for impressions: we " see " snakes, " hear " our name called, or " feel " a hand on our shoulder: we have hallucinations.

Further, impressions are stable, constant, as stubborn as the external world which arouses them; but images

frequently flicker and die away just when we are most anxious for their radiant presence. You can test this by trying to multiply, mentally, two numbers of two or three figures each. Because our images refuse to " stay put," the average person has to resort to maps, models, diagrams, and other objective aids. This explains the value of such apparatus in the schoolroom.

Galton tells of a barbarous Eskimo who drew from memory a chart of the region over which he had at one time or another traveled in his canoe. It extended 1100 miles straight, or six times as far when indentations of the coast were counted. This chart was found to agree remarkably with the government map. Galton states that he has never known of any traveler, " white or brown, civilized or uncivilized," who could equal the feat. (See *Inquiries into Human Faculty*, article on *Mental Imagery*.)

Chess players who carry on several games at once, blindfold, have an intense and stable brain photograph of their various boards, and call to mind the picture of each, with the position of the men on it, whenever necessary.

Kinds of image. — Since an image is the brain's attempt to reproduce an impression, we should expect the kinds of image to be the same as the kinds of impression. And so, in general, they are, though in any individual mind, a given kind of image may be used so little as to make the owner declare it is wanting altogether. The images in which we teachers are most interested are the visual, auditory, and tactual-motor.

We must remember, though, that a sense organ, — say the eye, — may be very keen and observant, without corresponding wealth and vividness of visual imagery

(Galton, *loc. cit.*). And Stout states that "a special command of certain kinds of imagery does not seem in general to be connected with any special fineness or vividness in the corresponding sensations [impressions]."[1]

The best way to study images is to experience and observe them. Picture the following to yourself, conscientiously keeping your attention on each until it has time to grow as intense as your mind can make it. You may wish to keep an introspective record of your pictures, and to grade their intensity by at least three figures, indicating faint, moderate, strong.[2]

A. *Light and color.* — An evenly clouded sky (omitting all landscape), first bright, then gloomy. A thick surrounding haze, first white, then successively blue, yellow, green, and red.

B. *Sound.* — The beat of rain against the window panes, the crack of a whip, a church bell, the hum of bees, the whistle of a railway train, the clinking of teaspoons and saucers, the slam of a door, a familiar melody played on a favorite instrument.

C. *Smells.* — Tar, roses, an oil-lamp blown out, hay, violets, a fur coat, gas, tobacco.

D. *Tastes.* — Salt, sugar, vinegar, lemon juice, a bitter dose of something, raisins, chocolate, currant jelly.

E. *Touches.* — Velvet, silk, soap, gum, sand, dough, a crisp dead leaf, the prick of a pin.

F. *Tactual-motor experiences.* — "Feeling" your way through a dark room, winding a watch, passing from a walk to a run, writing, dancing, tying a tie, buttoning your coat, playing an instrument, swimming, holding a weight until fatigued.

G. *Other sensations.* — Heat, hunger, cold, thirst, a headache, fever, drowsiness, a bad cold.

[1] *Groundwork of Psychology*, p. 113.

[2] The list is substantially that of Galton (see *Inquiries into Human Faculty*, appendix E), but I have changed it and added to it somewhat.

What is the use of images? — Gulliver, in his travels, found a people who carried with them samples of what they conversed about, so they could point to each object as it came to mind. But we have learned to substitute ideas for objects. Each of us carries his world in his head.

Your past experiences, as they come to you, have left their calling cards in the form of images. What is your past, as you recall it, but a panorama of ideas? The present world, distant lands, the solar system, vast astronomical spaces — these mean much to you and little to your dog because you have intense and stable imagery and he has not. Your future, for you, now, all the way from here to heaven, is simply a mental picture; inadequate as it may be, it is your only guide in preparing for that future. Here, again, you are much better off than your dog. Creative nature made a great step forward in passing from those animals which have little or no power of imagery to one whose whole mind is aglow with it.

We have but one stock of images. — Whether we are remembering, or imagination is painting its strange, new pictures, or thought is copying reality, we are using the same old images in different combinations, somewhat as we use the same old twenty-six letters in different combinations to write both good news and bad. The image of red is the image of red, whatever we do with it, just as *o* is *o* whether in *love* or *loathe*. We may liken our stock of images to the musician's hundred tones, combined and recombined into thousands of tunes; or to the men on the chess board, combined into endless fighting formations.

Evidently, if one's stock of images is scanty, he lacks

some of the counters necessary in playing the mental game. This is especially true of children.

Types of imagery. — We can see a landscape or hear vocal music better than we can hear the landscape or see the music. Just as we succeed best by using different senses on different kinds of material, so we succeed best by using various sorts of imagery for various purposes. Geometry makes no noise: you cannot hear it, nor can you easily solve its problems in terms of auditory images. Here, visual imagery is serviceable, although Galton found that even geometers can get along very well with but little of it. Visual imagery has proved to be best in such feats as spelling words backward; and he who attempted to visualize all his music without even hearing the notes in his mental ear, would make a poor vocalist.

Assuming that each imager has his own preferred type of imagery, which he uses whenever possible, the attempt has been made to classify all into four groups, visual, auditory, tactual-motor, and mixed. But careful investigation shows, first, that it is often hard to tell just which kind of imagery is being used, especially if the subject is one who has not learned to introspect well; and secondly, that types of imager are much less clearly marked than had been supposed. However, two groups have been distinguished, (1) the versatile, and (2) the non-versatile.[1]

(1) The versatile imager uses all the common forms of imagery with ease, changing from one to another according to his purpose. So, Titchener tells us he lectures, now by

[1] See *The Diagnosis of Mental Imagery*, by Mabel Ruth Fernald, Vol. XIV, No. 1, of the Psychological Monographs.

visualizing his manuscript, now by following his own voice, which seems to sound ahead of him, now from kinæsthetic images connected with the vocal organs, using all three guides, perhaps, in the course of an hour.

(2) The non-versatile group are characterized by what they *lack*, rather than by what they have; for it seems safe to say that even among non-versatile imagers, the majority have fair mastery of more than one kind of imagery, shifting according to the demands of the task. One may even perceive visually — say a page of music — but remember it largely by tactual-motor imagery. And if he were a versatile imager he might then solve his musical problems, compose, perhaps, in auditory terms. So he uses different parts of his brain for different purposes.

To sum up: each of us may be found to possess any kind of imagery, and in strength ranging from near zero to the vivid intensity that gives rise to hallucinations. For efficient mental work, it is probably best to use, in any task, that kind of imagery which, in the long run, forces itself to the front when we persistently set our minds on the achievement of that task.

So we find, as in the oft-quoted case of the coöperating play writers, Scribe and Legouvé, different workers doing the same kind of work with different kinds of imagery. Said Legouvé to Scribe, "When I write a scene, I hear and you see. At each phrase which I write, the voice of the person speaking strikes my ear. The diverse intonations of the actors sound under my pen as the words appear on my paper. As for you, who are the theater itself, your actors walk, they bestir themselves under your eyes. I am auditor, you are spectator." "You are perfectly

right," said Scribe. "Do you know where I am when I write? In the middle of the stalls."

Individual peculiarities of imagery. — Galton,[1] the classic investigator of this interesting subject, showed the "vast variety of mental constitution that exists in the world, and how impossible it is for one man to lay his mind strictly alongside that of another, except in the rare instances of close hereditary resemblance." So great were the differences that some were "scandalized and almost angry" at the "heresy" of others.

Some of the most striking peculiarities were: the common absence of imagery — at least visual imagery, among scientists; great differences in vividness; the ability to visualize all round a solid by a kind of "touch-sight"; or to see all the rooms of a house as if it were made of glass; color associations; visions; number-forms.

Thus, letters may be ideated in color. One reports that he has always associated certain colors with certain letters, and cannot change the color of a letter, so to speak, by any effort. Further, such letter-color is always clear in hue and definite in outline. The word "red," strangely enough, takes on the color of light green. "Yellow" is light green in its first syllable and red in its second. So certainly do colors call up their corresponding letters that this person, when perplexed as to the spelling of a word, can decide the matter by recalling the *color* of the troublesome word.

Another striking case is that of a well-known authoress who, while somewhat "fidgeted," but not to the point of illness, saw the chief character of one of her books, in size

[1] See References at close of chapter.

like a large doll, enter her door, approach her closely, and then suddenly disappear. Many others hear voices or see visions. So common are these supposedly uncommon experiences as to lead Galton to comment on the frequency of the hallucinations of the insane among people of good health and social standing.

Some of these peculiarities, especially the number forms, date back to early childhood. They take all kinds of fantastic shapes, one of which is here reproduced (Fig. 30). The owner of it explained that the figures from one to twelve were seen as on a clock face. Other peculiar number forms are traced back to dominoes, cards, an abacus, the fingers, feet and inches, or the hills and dales about the childhood home. Children who have fantastic imagery may refrain from talking about it because of the fear of ridicule. They should know that their case is just uncommon enough to be interesting.

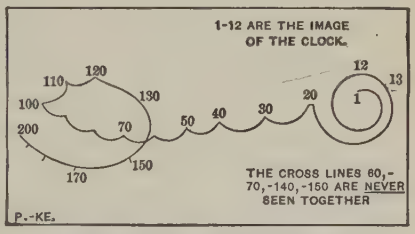

FIG. 30. — A visual number-form. (After Galton.)

From picture to symbol in imagery. — When primitive man wanted to make a record of events, he often did so by means of picture language. Our own alphabet was originally a series of pictures. But the accumulation and repetition of such pictures is too burdensome to bear. Fond as you may be of your friend's photograph, you would not attempt to reproduce it every time you refer to him: you prefer to write his name, using symbols which do not at all resemble him, but which *mean* him nevertheless.

As the race has passed from picture to symbol in its writing, so each developing mind passes from picture to symbols in some parts, at least, of its imagery. We may even distinguish a stage halfway between: when you draw a picture a thousand times, you may at length make it so carelessly, that it is rather a symbol than a picture; and so an idea repeated a thousand times may become so vague, distorted, fragmentary, as to be symbolic. Stout says that when he thinks of St. Paul's there floats before his mind a vague picture of something cup-shaped, but states that if this cup-shaped mental picture could be made over into objective form so all could look at it, it might not make anybody else think of St. Paul's. "I might have used the same image for representing a mosque in Constantinople, or even for representing Constantinople itself." [1]

If you want examples of symbolic imagery, you can probably get them by observing what enters your mind at the call of each of the following: *above; before; around; if; why? how? progress; long, long ago; millions and millions; exalted; polygon.* These words show the reasons why we are compelled to resort to symbols: we cannot well picture (1) individuals in a large collection, as 10,000 men; or (2) an abstraction, such as time, or folly, or polygon.

As before indicated, Galton found that scientific men are weak in picture-imagery. He concluded that the use of very vivid pictorial images is unfavorable to the habits demanded by abstract, verbal thinking, and that vigorous abstract thinkers are likely to lose the power of "seeing the pictures." The highest type of mind, he thought, does not wholly lose the picture-seeing faculty, but keeps it

[1] G. F. Stout, *Groundwork of Psychology*, p. 106.

only for those special cases that demand it. Yet those who cannot make use of pictorial mental imagery, have other ways of representing things to themselves, perhaps a kind of imagery whose units are muscular rather than visual, but which serves them so well that they are experts in expressing their experiences, either in words or by painting.

In teaching, the common danger is that we shall use too many symbolic images and too few of the picturesque, concrete kind. Pretty certainly it is the highest level of the brain that we are calling into play when we use abstract imagery, and our pupils may still be living on the second, that is the sensory, level.

It takes them off their feet when (for example) we pass from arithmetic to algebra, and instead of multiplying a number of dollars by a number of days, multiply x by y; or when we speak of the *flora* and *fauna* of a country instead of its plants and animals. They feel that we are getting high flown and shooting over their heads. They "don't understand it."

It is a good thing for us teachers to express in several varied forms that which we have to teach, taking pains to include many picturesque statements and many perceptive examples, that each pupil may embrace the truth in the dress that most appeals to him, somewhat as men of many countries all appreciate values best in terms of their own home coinage.

What is imagination? — Imagination, as the name implies, is an imaging process; but so, also, are memory and thought. And, as already stated, we have but one set of images with which to remember, imagine, and think —

one set of counters with which to play three games. The difference is this: memory gives us the was-so; imagination, the might-be-so; and thought, the must-be-so. There is a difference in the feeling that accompanies each. Memory, we found, carries with it a feeling of familiarity. Imagination is betokened by a feeling of newness, strangeness; thought, by a feeling of reliability.

Imagination, then, is analysis or association accompanied by a feeling of newness and strangeness. To remember is to retrace the old. To imagine is to explore the new. I remember the appearance of a horse and a cow; but if I combine the two into some sort of cow-horse or horse-cow, I am imagining.

What is imagination good for? — We are wrong if we think imagination is found nowhere except on the back of Pegasus. It is not only desirable, but demanded, by the most prosaic act of the most humdrum existence, if we would perform it efficiently. Plowman, smith, penman, carpenter, ditch digger, tailor, architect, mason, musician — each is a better artist if he can form a clear idea, before he attempts his task, of how it should look or sound when it is finished.

He, too, who would be served, must have some vision of the service he desires. It is imagination which pictures the various kinds of haircut, dinner suit, gown, house, that you might have, and the effect of each, enabling you to choose wisely.

Combinations of colors that disagree to the fighting point, sickening mixtures of food, mismatched appointments and events, the awkward, disgusting, and disorderly everywhere in human arrangements, are usually so much

evidence of lack of imagination on the part of the plan-maker. Imagination is the father of order.

Further, imagination precedes every carefully chosen word and every deliberate act. The fluent speaker seems to have a sort of moving-picture flight of ideas preceding the flow of his words and suggesting their choice. And the clearer the ideas, the more ready and apt the expression. One of the best ways to learn a new movement is by first picturing it with great clearness and then performing it. After much practice, the imagery which at first preceded the act, drops out, and the course of nerve action is direct from stimulus to performance. So, an expert, asked to tell how to perform a certain act, may be at a loss to do so, but will gladly "show you." The imagery which once directed his movements is no longer present to suggest descriptive words.

Only by imagination can you picture all your possible futures, so as to choose the best. The same power which saddens the dream of what might have been, gladdens the vision of what may yet be.

Our pupils can make no rapid advancement unless they can *see* things, that is, imagine the next step of progress before they take it. In writing, they should be able to picture clearly the letter they are striving to make. In arithmetic, perhaps the most frequent failure is the failure to imagine clearly the conditions of the problem. Subjects like history and geography are almost meaningless without this power of picturing. In the good-conduct class, it is useless to contrast the good way of life with the bad unless the pupil can send his mind ahead sufficiently to see to what different ends the white way and the black one lead.

Kinds of imagination. — We can easily distinguish two kinds of imagination, the *imitative* and the *creative*.

Imitative imagination aims to copy something that already exists either as object or process in the physical world or as idea in the mind of another. Creative imagination aims to produce something which, so far as the imaginer knows, never existed before. Imitative imagination finds its stimulus and its model outside itself, serves as interpreter : for example, in reading, we try to rebuild, to imitate, in our own mind, the picture the author had in his. Creative imagination is originative, makes its own model, forms the first pattern idea for manifold imitation. Imitative imagination adapts us to what *is:* creative imagination shows us how to change what is to what *ought* to be.

Essentials of effective imagining. — First, here as everywhere, stands *purpose*. The inventor succeeds by keeping his attention firmly on what he hopes to achieve, until means for its accomplishment suggest themselves. The artist, waiting for his picture to shine out in his mind before he can brush it on to the canvas; the poet, who feels his poem as a whole before he can add line to line; the prophet or statesman, trying to make clear his vision of a future state as a guide to the reforming of the present government, — all these feel themselves possessed of a purpose so strong that they sometimes believe they are directed by superhuman powers.

There is danger that we shall dissipate our creative energies on imitative imagination, as on too much fiction and too many moving pictures. These are good stimulators, which should challenge us to pass on to productive accomplishment of some kind.

Secondly, abundant material is necessary. Even creative imagination can not work up a world out of nothing. Creating or imitating, we can use only such images as we have; and we can get our free images in no other way than by abundant perceiving and careful analysis. We should take pains to gather material of the kind we are most likely to use. Scott, like so many others, took, as a basis for a projected work, some story already existing. To a friend whom he was visiting, he remarked, "You have often given me materials for romance: now I want a good robber's cave, and an old church of the right sort." On finding a suitable cave, he made note even of the wild flowers that grew about it, explaining that an author who tried to furnish natural surroundings out of his mind, so to speak, would come to show in his descriptions a monotonous repetition instead of the endless variety and fine fitness that nature displays in her settings.

Granted persistence in concentrating on any purpose until suggestions, associated ideas, begin to play freely about it, the next essential consists in selecting and rejecting the ideas that apply for recognition. We must treat them as we do candidates for a position. Many, perhaps most of them, can be dismissed at once as obviously unfit. Others, especially the new and strange, should be passed from a casual to a careful examination. None must influence us unduly because of previous acquaintance. And finally, if we would have the best service, the best must be chosen to serve.

All we can do is to follow the lead of our best ideas, retracing if necessary, until we strike the path that leads to our goal.

The schoolroom application is obvious. If we want a pupil to imagine well, say in connection with a composition, linguistic, musical, pictorial, or in handicraft, we must (1) see that he has a subject which fires him with purpose, must (2) furnish him plenty of mental material to make his imaginative pictures of, and (3) encourage him to be self-critical, to pick and choose among his eager ideas until only the best stand forth unified into a final product that is altogether good.

Limitations of imagination. — One who has not learned the laws of mind is liable to suppose that imagination is like the genius of Aladdin's lamp, capable of producing anything if only it is properly commanded. The teacher may assume that if he but does enough explaining, the imitative imagination of his pupil can follow anywhere. But the " world " which the child carries in his head is a small one, and he can no more imagine without images than he can build a brick wall without bricks.

Nor does creative imagination possess the divine power of making a world out of nothing. The creative genius, when he is called a genius, usually points to the toil — terrible to one who does not love it, which lies back of his product.

We must encourage the feeling of expectancy, for to expect the appearance of any mental product is to increase the chances of its appearing. But we should realize that the mind cannot create new images nor new laws of combination: it is limited to the old stock of materials and the old ways of grouping them. The best we can do is to choose the finest ideas that present themselves as we persistently follow the lead of an alluring purpose.

CLASS EXERCISE

The purpose of the exercise is to find out how the mind works when trying to imagine (invent) a new game.

To furnish an abundance of concrete material, the instructor may bring before the class several games which involve a variety of apparatus (say dominoes, euchre, a dice game, and checkers), and briefly describe the method of playing each.

Let the class analyze each game, noting sizes, shapes, colors, spots, designs, etc., of the playing apparatus; methods of dealing out, choosing, or placing, cards, counters, etc.; and rules of procedure.

Create a new game, involving (1) a new kind or combination of apparatus (such as triangular faced dice), or (2) a new method of starting (as allowing each to draw cards as he does dominoes), or (3) new rules for playing, or all of these.

Introspective reports and discussion.

FOR FURTHER STUDY

1. A dog, a schoolboy, and an old soldier, are all looking at their country's flag. Describe and explain what you believe to be the state of mind of each.

2. Tell, in a general way, what experience is necessary before a child can picture to himself what he finds described in his history.

3. Try to imagine the following: A tall-short man passes east-west along the corridor, steps into an enormous little elevator, and goes both up and down at once. Describe and explain your imagery.

4. Make a list of the "common branches" and tell what part you think imagery and imagination have in each. Does mathematics require imagination?

5. Discuss "Dangers in the Use of the Imagination."

6. Betts says (*The Mind and Its Education*, p. 134): "What youth, taking his first drink of liquor, would continue if he could see a clear picture of himself in the gutter with bloated face and bloodshot eyes a decade hence? Or what boy, slyly smoking one of his

early cigarettes, would proceed if he could see his haggard face and nerveless hand a few years farther along?"

Discuss further the value of imagination in living the good life.

7. Hold your mouth open, and at the same time imagine intensely the sound of *b* and of *p*. What happens? Why?

8. Do you think a hen, when she sits, imagines the chicks-to-be? Should you not defer judgment on this till you have further evidence?

9. Describe your imagery in connection with (1) a problem in mathematics, (2) a paragraph of history, (3) a scientific description, (4) a stanza of poetry, (5) an attempt to draw or construct from memory, (6) the words "Forward! March!"

10. Describe your imagery suggested by these words: What? Run. Up. Calm. Of. Therefore. Bah! How?

11. Give examples of imitative imagination. Of creative imagination.

12. Do you think imagination is subject to the laws of Brain Set, Mental Set, Intensity, Frequency, and Recency? Tell why or why not, and illustrate.

13. In performing the exercise at the opening of this chapter, how would your name appear if you turned your back to the (imaginary) mirror and looked into a second one in such a way that your name was reflected twice?

14. In a stereopticon, all rays of light cross as they pass through the lens. If there is printing on a transparent slide placed between the light and the lens, how must this printing be placed so as not to be inverted or reversed when thrown on the screen? Draw a figure if necessary.

15. Fold a square paper along a diagonal, then bring the two acute angles together and flatten the triangle thus formed. Cut off the right angle. Before unfolding, draw the square as you imagine it will look when unfolded. Were you right?

16. Tell how you would proceed to discover, among your pupils, individual traits of imagery that would prove of value in teaching them.

17. "We have but one stock of images." How can we make sure that our pupils have an abundant stock of them?

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CHAPTER XII

THINKING

Exercise. — (1) Remember some of the events of yesterday. (2) Imagine what you would like to put into an ideal day. (3) Think out some things which you feel sure will happen to-morrow. What differences do you find among these three kinds of mental activity?

If one could remember and imagine, but could not think, how would he be likely to act?

At the opening of the last chapter, it was stated that Imagining and Thinking are two especially valuable ways of analyzing and associating experience. We have studied the first. Thinking comes next.

What is thinking? — A young lady in a psychology class, performing an exercise in mental synthesis, placed a " fair maiden " up in a tree, which her lover, a shepherd swain, was unable to climb. But his trusty dog " ran playfully up the tree " and frightened the maiden so that she fell on the soft and woolly backs of the assembled sheep! One can imagine this, but can hardly think it; for thinking is imagination regarded as truthful, and so believed. *Truthful* means " picturing, or corresponding to, or harmonizing with, reality." And reality is what actually was, is, or will be. However, we commonly extend the idea to what could or would be under certain conditions. " If wishes were horses, all beggars might ride." Wishes are not horses, and not all beggars ride. Yet this is a true statement, harmonizing with reality.

The world is covered with a network of roads, all of which lead somewhere; but one only, perhaps, will take me where I want to go. So, imagination is the great mental road-builder, filling our minds with a web of associations which show how things might be; but one only, perhaps, of all these pictured possibilities, is true. To think is to select the mental road that leads to reality.

One of the teachers of my childhood days mystified us by sticking a bit of paper on the nail of each of two fingers, one on each hand. She then caused these papers to disappear and reappear by throwing her hands back over her shoulders and calling, "Fly away, Jack!" and "Come back, Jack!" We imagined (1) that she might stick these papers on her shoulders and then snatch them again; (2) that she held them in her hands and deftly placed them on her fingers at will; (3) that she left the papers in place, but showed different fingers at call. We finally found, by close watching, that this last guess was the true one, that it gave us what "really was so." The most thoughtful scientist proceeds in a similar way to find the truth.

The general, sitting at headquarters, gets news by telephone from all his fighting units at the front. On a map, he has a marker to represent each company. This he moves as the company advances or retreats, removing it if the company is captured or destroyed. Thinking is similar. The mind is the map; images are the markers; reality, especially the big objective world in which we live, is the actual battle field. Not that the mind is unreal: the map is just as real as the battle field. But the heart and soul of our effort is to represent correctly something

real but not present and perceived. As we get news through our sense organs, we arrange our mental markers accordingly. Thinking is setting our images in order. In what order? In what we believe to be a truthful order, the order of reality.

The belief which marks the truthful association and distinguishes it from the merely imaginative, is a feeling of *reliability*. You can imagine your favorite team winning the next game; but do you think it will? Would you rely on that outcome, back it up with action? Unfortunately, the feeling of reliability is often induced too easily, before all the possibilities have been thoroughly explored. "Talk is cheap," if we talk merely what might be, what we imagine. But when some one challenges us, asking "What will you bet?" he is getting a price on our talk, and so finding the measure of our feeling of reliability.

Thinking is mental analysis or synthesis characterized by the feeling of reliability.

The value of thinking. — The animal that has succeeded best in his environment is man. The animal that thinks best is man. Thinking enables us to predict, to control, to succeed.

Just how? If a traveler sees many roads before him, but has no idea as to which to follow, it is a mere accident if he takes the right one. So, if we could imagine numerous possibilities, but were thoughtless, had no feeling of reliability in this direction or that, we might as well follow any whim or impulse, as thoughtless people do. But many of the so-called thoughtless are really imaginationless. They have few free images, and can not imagine any course of action clearly from beginning to end. Like

the lower animals, they follow the feeling of the moment. By careful thinking, we are enabled to deal with things absent as if they were here, with things past or future as if present, and with things involved and mysterious as if open and evident. For example, you may have a triangle here and now before you, and yet not know that the sum of its interior angles is 180 degrees, until you think the matter out.

The perfect thinker would be one who had in his mind an image for everything in the universe, who could combine these images freely, and who always knew when his mental pattern was repeating that of reality.

How thinking goes on. — A child, on scanning the sky some starry night, wonders why one star appears so much bigger and brighter than all the rest. He recalls a few other such giant stars. Perhaps they are older than the others, and so have grown bigger, as his big brother is older than he. But when he suggests this, people laugh: probably it is not true. Perhaps there are holes of different size cut through the sky. Then the moon must be a very big hole. But how could a *hole* look like a man, and how could it rise and set? Besides, he has heard some one say that the moon is really quite small, but looks large because it is so close. Headlights and lanterns look larger as they come closer. The big stars look big because they are closer. And the sun, being so very big and bright and hot, must be very close.

What are the steps in this process? (1) A wonder-situation. The interrogation point is the thinker's trade mark. (2) Imagination suggests one or more solutions which must make their way if they can, or (3) be inhibited,

overpowered, thrust aside by opposing ideas. So, the suggestion that stars are sky holes was inhibited by what was observed and reported of the moon. Among ideas, might makes right, and the fittest survive. (4) At length, an answer may arrive which seems to harmonize with everything the thinker knows. Belief follows — and relief, too, usually: his feeling of reliability is proportional to his success in securing harmony among his ideas. If there is something strong and positive to inhibit every doubt, he is *sure*. (5) This established truth becomes influential, in the community of ideas, in determining whether any new idea shall receive recognition. If stars look big because they are near, no doubt the sun does, too.

Naïve and reflective thought. — Most children, and many grown people, think in the naïve, uncritical, unreflective way illustrated above. But suppose the child, in later life, becomes an astronomer. How now does he attack such a problem?

(1) He begins by stating his question with the greatest care. He does not assume that the big " stars " are stars at all, but keeps his mind open on that point. They may be moons. His problem is to find what makes the difference between the larger and the lesser lights of starlike appearance.

(2) Experience has taught him that it is best to emphasize facts first and theories afterward, and so avoid the danger of becoming biased, tied to this theory or prejudiced against that. As I have said elsewhere,[1] the common tendency is to jump at conclusions and dodge the facts,

[1] In *The Science and the Art of Teaching*, Ch. XIV, on "The Lesson for Thought." See also Chapters I and X of that book.

whereas we must learn to jump at the facts and dodge conclusions. Accordingly, our astronomer goes on observing. He notices, among other facts, that these larger lights do not twinkle as stars do, and that they wander slowly about among the fixed stars.

(3) He is more *persistent* in imagining every possible theory and in subjecting each plausible solution to the most thorough tests. If these wanderers are larger merely because closer, then how explain the wandering, the lack of twinkle, and their peculiar color?

(4) The solution which he feels forced to accept, which gives him the greatest feeling of reliability, is permitted only gradually to take standing as an established piece of knowledge. It is first a " hypothesis," a well-considered guess, then a " theory," and finally, if it can run the gantlet of a long array of critical fellow scientists, it becomes a scientific fixture, perhaps a " principle " or " law."

No astronomer can now doubt that these wanderers are planets (from *planes*, wanderer), or that they move about the sun and shine by its reflected light, and so are more like moons than stars.

(5) The critical thinker is more careful in drawing conclusions from accepted knowledge. The child was right in thinking that the " big stars " look big because they are closer, but wrong in thinking that the sun, since it looks so very big, must be very close.

Our greatest thinkers show wonderful application and persistence in seeking the right conclusion. Newton, when asked how he achieved his marvelous results, replied, " By always thinking about them." It is told of him that he would pause in his dressing and sit for an

hour with toilet incomplete, lost in some problem. Darwin used to sit, apparently staring at a flower bed but actually deep in thought, for hours at a stretch.

How psychology passes into logic. — As appears above, the general course of critical, reflective thinking is the same, point for point, as that of naïve, uncritical thought; but the critical thinker is more cautious, vigilant, thoroughgoing, and deliberate at every point than the child. He began as a naïve thinker himself, and has gone wrong many times; but he has noted the danger points and is determined not to be fooled again.

The whole situation is like that of navigating difficult seas, full of shoals, rocks, and quick currents. The untried sailor reaches port by luck, if at all. There are many wrecks. But gradually, lighthouses are built, buoys are placed, the seas are charted, the art of navigation is perfected. Thenceforth, the expert sailor is practically safe.

The naïve thinker is the unskilled mariner on the rocky sea of reality. There have been many blunderous wrecks. But gradually, the danger points have been marked, the course charted. The scientific art of thought-steering now makes the expert thinker reasonably safe.

This scientific art is Logic. It is to be wished that every teacher could master it, especially its more practical side. But here we can only call attention to a few psychological essentials.

Why naïve thinking persists. — We teachers, anxious to reform the world, could do it if we could teach every one to think straight, and then to act as he thinks. Back of all bad conduct is a faulty idea of some sort. If we are to

correct naïve thinking, we should know what causes it, and remove the cause.

Now, we have found that minds work, in general, according to a few familiar laws. Let us look to them for help.

Brain set. — One disheartening difficulty is that so many imperfect brains are born into the world. Judging from the way many of them respond, or fail to respond, to their environment, certain neurones must be either lacking or not functioning. Inborn ability grades from idiocy and folly up to wisdom and genius. No teaching can correct hereditary brain weakness; but eugenics holds out a hope for brains better born.

One great curse resulting from brain set is *tradition*. You can easily see how every one outside your own church is biased by it. Nor is it found in religion only: it sways society, keeps tyrannous governments alive, preserves "red tape" even in a democracy, supports the quack, enslaves the farmer. Many farmers still watch the moon for signs to tell them when to plant beans and potatoes, kill pigs, set fence posts, etc. Cucumbers grow longest, they think, if planted on the longest day of the year! The weather on the second of February tells whether to sell or keep the hay, etc. Tradition inoculates the child as he comes from the cradle, and cramps and shackles his mind — a fate much worse than cramping and shackling his body.

We must compel this muttering and jabbering in the dark to come out into the daylight and prove itself. Each must reform his own mind until he no longer fears to break a mirror or sit with twelve others at table. Then let us challenge tradition wherever we find it, and insist, so far as we can, that the minds of children shall be left *free*.

Mental set. — The chief danger here is from our feelings, which would lead us to take sides first and find the reasons afterward. But as a judge, watching two unknown parties contending, cares not which wins, but is determined on a fair trial, so every thinker should be unprejudiced as to the issue of his thought, but see to it that the contest is well conducted.

Suggestions also work powerfully, even when self-administered. Sir Francis Galton cut out a comic picture from Puck, set it up, and made believe that it had divine powers. He soon began to feel that this ridiculous creature had considerable influence over him.

This explains the halo of awfulness which some contrive to throw about themselves. We respond to these suggestions of superiority and permit such people to "get away with it." We should respect real ability, but assumption and pretension need treatment of some kind, perhaps by ridicule or a policy of non-intercourse.

Ignorance is one very common cause of prejudice. The individual who is ignorant of anything, such as a proposed reform, is likely to feel "cheap" if not ready to act on it when others do, yet he runs a risk if he accepts the unknown; and further, because he is humiliated if found ignorant of a *good* thing, he is likely to pronounce the new thing *bad*.

Intensity. — Unfortunately, events are so strung together in this world that we are often impressed with connections of no importance. It is said that war follows the appearance of the "northern lights" (aurora borealis). Probably it did once, and in a striking way; but one fact does not prove such a case, any more than one bird makes spring.

Then there is often a *lack* of intense, impressive facts to support the truth. This is why the expert thinker so often relies on experiment. The old-fashioned farmer, seeing the success of his scientific neighbor, begins to look with open eyes and mind on the " new-fangled."

Further, even logical minds are in danger of being too much impressed by statements printed in colored ink or large type, or which are made with loud voice and emphatic manner. The sunrise gun or the crow of a rooster may attract our attention more than the sunrise itself. Unfortunately, the less certain some men are of a statement, the more loudly they roar it abroad, as if to puff up their failing confidence with noise.[1]

Frequency. — The liar, by repeating his tales, may arouse in himself the feeling of familiarity and come to believe his own yarns. Similarly, any statement, true or false, repeated many times without question, induces the feeling of reliability and comes to be " so " whether it is true or not. " I believe. . . ." Write after these words anything you please that is not constantly refuted by your experience, say it over frequently and seriously, and you will probably wonder, in time, why any one should ever doubt it. " There is luck in odd numbers ! " Yes, half the time: for just half the numbers are odd. " There is luck in even numbers," and to the same degree. But this arouses less belief because we have heard it less often.

[1] The old doggerel gives popular expression to this psychological fact:

"It isn't always the wisest man
Who has the most to say:
The base drum makes the biggest noise,
But is easiest to play."

Here is one reason for the election cry, the motto, the slogan, the ceaseless repetition of certain advertisements. What everybody is saying, or what meets us at every angle, is likely to overpower us at length by its mental mass and momentum, to induce the feeling of reliability, and so to get itself established as true.

Recency. — Every brain seems to have a little putty in it, and to hold best that which impressed it last. The last lawyer before the jury, the last debater to get the ear of the judges, the last salesman to appear before the purchasing committee, — in short, the one who, in any situation, can get the last word before action, has an advantage. To some minds, the latest is the truest, and the most recent rumor arouses more belief than the most fixed and ancient facts.

Essentials of good thinking. — As stated above, the perfect thinker would be one who (1) had images to represent everything in the universe, (2) who could form freely all probable combinations of these images, that is, imagine all possible or probable hypotheses, and (3) whose belief, or feeling of reliability, always clung finally to the correct hypothesis.

Very likely this is an unattainable ideal; but it is worth while to struggle constantly for (1) ideas which are abundant and accurate, (2) freedom of imagination in combining and recombining our images, and (3) improved means of knowing when the truthful combination is found.

Let us consider each of these.

(1) **Storing the mind with images and ideas.** — We can secure an abundance of ideas by wide experience and careful observation, supplemented by penetrative conversation

and reading. Our minds are naturally hungry for ideas. We go eagerly to see moving pictures, and listen with pleasure to him who tells us of foreign lands. We can give accuracy and edge to our ideas by persistently trying them out on the stubborn world of fact, attempting to predict and to control, analyzing and re-synthesizing each until it just fits the fact it stands for.

So the child is likely to regard poetry as "stuff that rimes." Later, he finds that he must take down and rebuild this idea, that there may even be poetry without rime. Appendicitis was long called "bowel complaint," or other similar name. The vague idea of "something wrong among the intestines" has now been rendered more exact by further information and careful discrimination. We may even find an idea with nothing corresponding to it. Such is the idea of phlogiston, a substance which, as the older chemists believed, flows out of a body when it burns. Further, two ideas, supposed to have no relation, may be found to refer to the same fact, as the English word *horse* and the Latin *equus* refer to the same animal.

(2) **Securing variety of hypotheses.** — A fertile imagination is one of the first requisites of successful thinking; for we cannot consider the ideas which never enter our heads. Nor is there any known way of going out and capturing the right hypothesis and compelling it to serve us. But we can and should steer away from the paths of prosy platitude and encourage our associations to loosen up and joggle themselves together in patterns that are new, even if bizarre and fantastic sometimes. Here is one of the serious uses of wit.

These, however, are only our setting-up exercises. If

we are ready for the serious labor of truth-finding, we must work our way thoroughly through the whole list of facts. If any seem to be of key-importance, we can imagine them removed — what would happen? Those that are minute can be magnified by the microscope of exaggeration, and the more bold and imposing ones looked at through a reducing glass. We can even import events: "How would this situation be changed if so and so were brought to bear on it?"

If now, all these devices are backed up by perfect familiarity with the series of facts we are dealing with, we may hope to find our way into the room where sit the gold, silver, and iron chests, and make ready to choose the one that contains the treasure.

(3) **Recognizing the true hypothesis.** — The critical and patient thinker is likely to accept, in the end, that solution which harmonizes best with all the knowledge he has. But as he runs through his stock of knowledge, he finds that its various items arouse different degrees of belief, strong or weak feelings of reliability, depending largely on how these items were acquired. Now, all our knowledge is gained in one of the four following ways:

(1) *Observation not followed by inference;* as when a boy observes his mother doing housework, but makes no inference as to the order in which the work is done.

(2) *Observation followed by inference;* as when the boy, having observed his mother for weeks, infers that she follows a certain order, washing on Monday, ironing on Tuesday, etc.

(3) *Inference followed by observation;* "Mother always bakes on Friday, so she will bake next Friday." Friday

comes and observation proves the truth of the inference, strengthening the boy's belief that he has found the order of his mother's housekeeping.

(4) *Inference not followed by observation;* "Mother must have gone through all this when I was a baby."

So, man observes his mother nature, the difference being that she cannot talk. The only way to question her is by experiment. We feel sure of what we observe, less sure of our inferences, reassured when inference is borne out by further observation, less secure when we extend an inference without being able to support it by direct observation. But in the mind of the critical thinker, that hypothesis survives which appears to have the best foundation, directly or indirectly, in observed facts.

Induction and deduction. — The basing of truth (1) directly or (2) indirectly on observed facts, gives rise to two kinds of truth and two methods of getting at it. The two kinds of truth are the inductions and the deductions; the two methods are the inductive and the deductive.

When a wonder comes, say as to whether one should eat heartily when he has a cold, there are two general ways of getting an answer. (1) We may fly straight for the facts, observe people with colds, some of whom eat heartily and others sparingly. We may even experiment on the matter. Or (2) we may think the thing out on the basis of what is regarded as already known, taking our stand on certain principles of physiology which appear to apply to the case, or even on such popular statements as "Stuff a cold and starve a fever."

The first method is inductive, the second deductive. An induction, then, is a statement (usually a general state-

ment) based on observation of the facts. Suppose the wonder question is, Why do some "stars" twinkle while others do not? We observe the heavenly bodies at night and find that "the planets do not twinkle." They shine with steady glow. We examine the true stars: Star A twinkles, star B twinkles, star C twinkles, etc. If we find none that does not twinkle, we may venture the inductive inference, "All stars twinkle." Now, we can observe all the important planets, but not all the stars: there are too many. And we must remember that every inference made without examining all the objects included, involves a risk. We can not well hunt the whole universe through; consequently, after we have made our inference, exceptions may be found. This compels us to go on thinking, and so increasing in wisdom. Naïve, reckless thinkers, especially children, are likely to rush into inference by the short cut of a few facts, forgetting that the longest way round is here the surest way home.

Deduction is constructing the answer to a wonder question by using the knowledge we find in our mental factory and not collecting any new facts. Induction, as we have seen, must have fresh facts. Deduction is pure brain work, and can proceed (once the mind has gained some little capital stock of truth) without the exercise of the observing organs. Suppose the question arises as to whether women are more savage fighters than men. "Yes," some one answers, "they are: for Kipling says 'the female of the species is more deadly than the male!'" Granted that "deadly" includes "savage in fight," and that "the species" includes the human species, then the question is decided.

But *is* it decided? No: it is simply referred to Kipling. And what right has he to make such a startling statement about females? None, unless (as the poem indicates) he has numerous observations (his own or others') of facts to back him up. The point is this: truth always rests on observed facts — directly in case of induction and indirectly in case of deduction. Deduction, it appears, is simply an extension of induction, the erecting of an additional story over the inductive foundation; but the foundation of fact must always be *there*.

Deduction, then, is not necessarily proceeding from a general statement to a particular fact, as it is so often said to be. It is simply the working over of old truth till we bring some new truth out of it. Every theorem in geometry is a general truth, yet nearly all are proved by deduction.

The great danger in induction, as already stated, lies in passing to our general "truth" too hastily; the great danger in deduction consists in relying on some general "truth" too carelessly. The world is overflowing with examples. Evidently, the most common trouble in thinking is with our general statements: particular facts in the outside world we can examine at our pleasure; but the proverbs, laws, principles which are urged upon us, and which may have their home chiefly in somebody's brain cells, these we must always regard with caution.

Judgment and reasoning. — The nice discrimination of the many technical terms used in what we may call professional thinking, we must leave to the study of Logic. But the words *judgment* and *reasoning* are in such common use that we should know their general meaning.

Thinking is finding relations. *Judgment* is the direct discovery of a relation. *Reasoning* is the indirect discovery of a relation. " Our baseball team is better than the X team." This is a direct comparison, a judgment. " We can beat the Y team, for X beat Y and we beat X." Here is a more complex, indirect comparison, a sample of reasoning. Since two or more simple judgments are always necessary, we may say reasoning is a (logical) combination of judgments. But whether the judgments are all true and all truthfully combined — " there's the rub."

Common sense. — As we found in studying memory, forgotten knowledge may have so set the brain as to influence its future action. It is not surprising then, to find that many who have good common sense, or practical judgment, can not always give reasons for their decisions. Like certain good, old-fashioned cooks who are only embarrassed by measures and scales, they have " learned by experience " until they seem to be guided by " intuition."

Subconscious cerebration has its value in thinking. Just as we often find it best to stop forcing our memory, and let it alone till it produces what we seek, so it is often best, having gathered the evidence in a case, to stop wrestling with the problem, and expectantly wait until the satisfying decision, apparently of its own accord, issues in consciousness.

Teaching children to think. — Children apparently do a great deal of their " thinking " subconsciously. At any rate, they have many wise intuitions for which they can not give the underlying reasons. We should not attempt to teach them the conscious science of thinking, but only the practical art, largely by practicing it with them in

conversational teaching, by bringing them into contact with good examples of it, and by showing them, from the daily affairs of life, how dangerous it is to take sides first and do our thinking afterwards.

Probably the greatest thing we can teach them is the proper attitude toward truth. One must set his mind, not on having his own way, but the way of the facts. He must be prepared to accept the election returns, so to speak, whether he likes the elected candidate or not.

The key to the right attitude is found by forming the habit of applying to every important statement these three test questions: 1. Just what does this mean? 2. Is it true? 3. How do I know? For example, what is the meaning of "Stuff a cold and starve a fever"? Careful examination reveals that an "if" is omitted. The meaning is, "If one eats very heartily when he has a cold, he will bring on a fever that will require him to go on limited diet."

The questions, "Is it true," and "How do I know," require that the pupil dig until he finds the foundation of *fact* for his statements. It makes little difference whether he digs inductively or deductively so long as he works intelligently.

The essential points are that he shall (1) see clearly the question at issue, (2) get an abundance of information about it, (3) let his imagination picture freely the various ways that *might* be so, and (4) finally follow the facts into the one way that *is* so.

Individual variations in thought power. — We must be prepared for all kinds and grades of thinking among our pupils. No single test is sufficient to determine whether

or not a child carries a good thinking machine in his head. There is a persistent but outworn belief that he who can think mathematics can think anything, and he who fails in mathematics can not think much of anything. But each has by birth a different brain set, an inborn tendency that turns him to one subject and averts him from others. Where we love, we think.

But there are grades, degrees of thinking ability, too. Dr. Bonser, in testing 657 children in reasoning, found that 90 per cent of the pupils in the 6A grade were below the best pupils of the 4A, that 4 per cent of the 6A pupils were below the middle group of pupils in grade 4A, and that the score of the best of the 4A pupils was three times as high as that of the poorest pupils of 6A. The rate of progress varies just as much: some children can go several times as fast as others and at the same time do better work. And all this among children of the same class.

In time, all schools, by their method of grading, will make allowance for these differences, and all teachers, in their methods of teaching, can do so immediately.

CLASS EXPERIMENT

Purpose. — To study induction and deduction.

Materials. — A pack of ordinary playing cards. (Larger cards, suitably numbered or lettered, may be substituted if the playing cards are too small to be seen plainly.)

Procedure. — The instructor may select the kings and queens and show them in pairs, as follows. (Let *K* equal king; *Q*, queen; *H*, hearts; *D*, diamonds; *C*, clubs; *S*, spades; +, with.) *KH*+*QH*, *KD*+*QD*, *KC*+*QC*, *KS*+*QS*. *KH*+*QD*, *KD*+*QH*, *KC*+*QS*, *KS*+*QC*. A new order, or further complexity, may be introduced at pleasure. For example, there may be added to the above;

$KH+QC$, $KC+QH$, $KD+QS$, $KS+QD$, etc. Or a simple problem may be solved first, a more complex one later.

The students may be told, definitely, that their problem is to learn to predict the order in which the cards will be shown, or simply asked to observe what happens and report any notable discovery. Repeat the showing of the cards until the "law" of their appearance is discovered by one, many, or all, as desired.

Deduction may be practiced by showing any pair of cards in the series and asking which pair will follow. "Are you sure?" "Why?"

Now show, with QH, a card not used before, as an ace or the joker. "What will follow?" "Are you as sure as before?" "Why?"

Introspection and discussion. What likeness and differences between this situation and the working out of the key to nature's mysteries?

FOR FURTHER STUDY

1. What is the difference between thinking and daydreaming?

2. Suppose you believe fully that fire will not burn you: will your belief make any difference? Suppose you believe fully that although you have heretofore been afraid of dogs, you are going to be so no longer: will your belief make any difference? In what kind of affairs is faith most valuable?

3. Give some celebrated examples of prediction or control due to thinking. What do you believe would have been the situation had the thinking not occurred?

4. Write out in some detail a case of your own thinking. Outline the successive steps, or stages.

5. State something that you "know," — something not too obvious. Introspect your feeling of certainty, and trace its source or sources.

6. A movement has been started to have inventors work in groups. Do you think they are more or less likely to produce great results than if each worked alone? Why?

7. Collect as many samples of naïve thought as you can, especially "signs," old sayings, and beliefs. Do you find any that seem

to be based on critical thought? Can you find in your experience anything that helps to explain the origin of belief in signs?

8. "I know it is bad for me and still I do it." What may be the trouble in a case like this?

9. If one makes a statement with loud eloquence, with confident air, glowing eye, and emphatic gesture, and another quietly tells you the opposite, which are you more likely to believe? Why? Is his statement any more likely to be true?

10. One student, on receiving a thought problem, sets to work with his pencil at once to answer it; a second sits with eyes fixed for a time and then writes deliberately. Other things being equal, which answer do you expect to be better? Why?

11. (A group may be assigned to work this out during a class period.)

a. Observation: Toss a penny 100 times. How many heads? Tails?

b. Inference: Try to state the "law" of its falling.

c. Inference tested by observation: Forecast the result from tossing it 100 times more. Try it.

d. Inference not followed by observation: If you could toss it a million times, how many heads? Tails?

12. Tell the nature of each of the following statements (that is, whether it rests on observation only, or observation followed by inference, etc.), what degree of certainty attaches to each, and why: 1. The moon sometimes shines at night. 2. The moon is much like the earth, but has practically no water, air, or life on it. 3. The almanac says the moon will rise at nine o'clock to-night; we shall see. 4. The inside of the moon is solid and cold.

13. Give original examples of the four kinds of knowledge, viz.: *a.* Observation not followed by inference. *b.* Observation followed by inference. *c.* Inference followed by observation. *d.* Inference not followed by observation.

14. Illustrate induction: deduction.

15. There are three fundamental reasons for faulty thinking: (1) lack of images (and ideas), failure to get the facts, ignorance, (2) lack of freedom in combining images so as to try out all probable

hypotheses, and (3) failure to detect and accept the true hypothesis. Which of these do you think is responsible for most errors?

16. One who has known a few frivolous girls and a few brave men, states that "Most girls are frivolous" and "All men are brave." How does he violate his rights as a thinker?

17. Can you remember the future? the present? Can you imagine or think about things past? things present? things to come?

18. Write on the topic, "How I can teach my pupils to be critical (and not mere naïve) thinkers."

19. Run through the various branches of study and discuss the amount and kind of thinking required by each. For example, what value has spelling as a thought study?

20. "Where we love, we think." Do you believe pupils do more thinking out of school or in? Along what lines? Why?

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CHAPTER XIII

AFFECTIVE EXPERIENCE: "THE FEELINGS"

Exercise. — Look at the picture below. How does it make you feel? Report what comes into your mind as you gaze on it.

We have finished our study of that kind of experience which is gathered from the outside world, and which, in the

FIG. 31. — What feeling does it give you?

form of memories, imaginings, and thoughts, helps us to deal with the environment, and to control or predict its operations.

We turn now to that kind of experience which is not gathered from without — at least, not so directly. One person likes a picture which his neighbor dislikes: now, the two perceptions of the picture must be quite similar,

but the two feelings that follow are opposite. We must look into this mystery of affective experience, the likes and the dislikes, joy and sorrow, grouchiness and amiability, attachment and aversion.

The popular term is "feeling," or "the feelings." In place of these expressions, the psychologist prefers "affective experience," or the "affective complexes." We can use the popular terms if we keep clear on the fact that a feeling, properly so called, is only one, a special kind, of "the feelings."

Has affective experience much importance? — Yes: so much, in fact, that it fixes the value, for *us*, of everything else. Salt, flour, silver, gold, and all other "goods," have value because somebody finds them good, likes them, wants them, will give time and effort to get them. What nobody wants has no value. Take all feeling out of life and life itself would be worthless.

As we should expect, then, affective experience is the great motivater, the great *mover* of man and beast. Jacob works seven years plus seven more for Rachel. See any creature persistently active and you may know that it persistently wants something. If nature would preserve her creatures, she must see to it that certain momentous ideas such as those of food-taking, love-making, and saving one's self when in danger, are carried into action. Accordingly, she electrifies these ideas with a glow of feeling. Our feelings, then, stand between our sensations and our acts, determining which perception or idea shall be followed. Given a purely intellectual idea, pale and perfect, opposed by one that is uncouth but full of the red blood of emotion, and we can usually foretell which will get control of the

sinews of action. Even the intellect, the thinking process, is but the servant of the "soul," that is, the feelings.

Review of sensation and affection. — As a means of understanding the affective complexes, let us review elements. We have found (Chapter VI) that mind is composed of but two kinds of element, sensation and affection. Affection is the simplest bit of like or dislike, of agreeableness or disagreeableness, such as the like or dislike that accompanies a sensation, say that of a color, a tone, a taste.

We may summarize our contrast of sensation and affection as follows:

Sensation	*Affection*
1. Referred to a particular bodily organ, as color to the eye.	1. More of a general thrill.
2. Definite and clear under introspection.	2. Less clear.
3. Follows its stimulus, precedes affection.	3. Is aroused by sensation, and follows it.
4. Stands for something not itself, usually something objective.	4. No direct objective reference.

As we should expect, the affective complexes, that is, those mental states in which affection is most prominent, are more vague and fluid than sense complexes, such as perceptions and ideas. It is difficult to predict or control the feelings. We can often tell what thought a thinker will think next; but it is hard to say what feeling a feeler will feel next.

Organic sensations and sense-feelings. — Here are further confusing currents to puzzle our analysis. In all our more stirring affective experience, such as strong fear

or anger, there usually appear massive sensations, indefinitely localized, from the maintenance systems: the heart throbs, the breath catches, the whole inner body may beat and flutter and heave.

Affections, uniting with organic and kinæsthetic sensations, form sense-feelings, as Titchener well calls them, which seem to be a kind of intermediate, half-breed class between sense complexes and affective complexes. It is his view that every stimulus, such as a tone, even, starts a considerable organic disturbance, and organic sensations, plus those of a kinæsthetic kind, make up the body of a sense-feeling. He distinguishes six classes of sense-feelings, the *agreeable* and the *disagreeable*, the *exciting* and the *subduing* (*calming*), and the *straining* and the *relaxing*. The paired terms are opposites.

Some of Titchener's classified examples of sense-feelings are as follows: Tastes and smells are very agreeable or disagreeable; deep tones are solemn, serious, and subduing, whereas high ones are cheerful, playful, and exciting; "warm" colors, such as red and yellow, are exciting; "cold" blues, subduing. "If you follow the strokes of a slow-beating metronome you get an alternation of straining and relaxing." [1]

Since it is in the affective complexes that both affections and sense-feelings appear in their greatest range of intensity and most tangled webs of combination, the feelings are the most complex of all human experience. Let us try to simplify them by stating their law:

The law of the agreeable and the disagreeable. — We can not separate the objects and events of our environment

[1] Edward Bradford Titchener, *A Beginner's Psychology*, p. 81.

into the always-agreeable and the always-disagreeable. Probably nothing we can mention could be placed in either class. Darwin, recounting a South American trip, says: "We saw also a spectacle, which my guides viewed with high satisfaction; it was the skeleton of an Indian with the dried skin hanging on the bones, suspended to the branch of a tree." Such a sight would seem to be always disagreeable if anything can be; but the Indian guides recognized the body as that of an enemy.

Confluence of mental (and perhaps neural) currents is agreeable; diffluence, disagreeable. — That which appears to fulfill a person's purpose, to get him what he wants, is pleasing; the opposite, displeasing. Observe at length what a man sincerely applauds, what he laughs at, what puts the glow of exultation in his eye, and you know your man, for you have learned the trend of his mind. "Reprove not a scorner, lest he hate thee: rebuke a wise man, and he will love thee." Grandparents abhor a racket, while grandchildren approve it. Their mental currents are flowing in opposite directions.

As in the case of attention (see Ch. V), we must consider the *force*, as well as the direction, of consciousness. When mental energy runs high, all opposition may be swept away easily. When the dancing dervishes are roused to frenzy, pain only brings signs of elation. If the mental tide is at low ebb, as in extreme fatigue or old age, even "the grasshopper shall be a burden," and no keen affective experience is possible. Peary states that, on reaching the north pole, the object of long years of desire, he experienced no triumphal emotion, but wanted chiefly to get home.

In making clear the course of one's mental currents, and

hence what will please or displease him, our five familiar laws will help. But we can do little more at this point than to mention them.

Brain set. — Most important here are *instinct* and *temperament.* As stated before, nature has cast a halo of feeling about certain types of behavior which are (or were) necessary to competitive survival and successful adaptation to environment. Examples are the tendency to find food, to fight, to ramble, to go in groups. Such types of behavior, with their accompanying consciousness, are called *instincts.* Now, instincts have inherited nerve paths, usually strongly marked. And although an instinct is commonly thought of as a *racial* trait, each of us is likely to have some instincts strong and others weak. If we know which instincts are strongest in any individual, whether he is first of all an eater, a fighter, a rambler, a lover, a property-getter, or what not, we know a great deal as to what his dominant feelings must be.

Temperament also means much, and it, too, is a matter of hereditary brain set. Some are by birth morose and irascible, others cheerful and affable.[1] When Sarah Pierrpont was thirteen years old, Jonathan Edwards, whom she afterward married, wrote of her: "She is of a wonderful sweetness, calmness, and universal benevolence of mind. She will sometimes go about from place to place singing sweetly; and seems to be always full of joy and pleasure; and no one knows for what."

Mental set. — Health is of high importance here. Whether we are sweet and smiling or sour and snarling

[1] Instinct is further discussed in Chapter XIV, Temperament in Chapter XV.

at any hour depends greatly on whether we have been eating, sleeping, breathing, exercising, working, and playing properly. The liver is well named; for it determines, in many cases, how we are living, so far as our feelings are concerned.

The more purely mental side of "mental set" is found in present purpose. Such purpose determines very largely what we can brook and what we can not abide. Lovers, desirous of being alone, find the conversation of the group stale and unprofitable, perhaps even unbearable. He whose sincere purpose is to find the truth is unruffled when his argument fails, for he is attached, not to any particular argument, nor to victory in debate, but to what actually is so. Says Thomas Browne, in the *Religio Medici*, "I cannot fall out or contemn a man for an error, or conceive why a difference in Opinion should divide an affection [friendship]; for Controversies, Disputes, and Argumentations, . . . if they meet with discreet and peaceable natures, do not infringe the Laws of Charity. In all disputes, so much as there is of passion, so much there is of nothing to the purpose; for then Reason, like a bad Hound, spends upon a false Scent, and forsakes the question first started." Here is the test between the partisan and the truthseeker. In games, also, we can usually distinguish, by the feeling shown, between the true sport and the mere game-winner who feels that he must get the game by any means.

Intensity. — The more intense the sensations, the more intense the affections that follow them. For this reason, a perception usually arouses more feeling than an idea. The object lesson strikes home. A shivering kitten on your doorstep may affect you more than a hundred deaths in China.

Frequency. — Other things being equal, any stimulus arouses the feeling most frequently felt in connection with it. Consider your attitude toward the church, toward your family, friends, and foreign nations. Study your most repulsive branch when you are happiest and freshest, and you may grow to like it.

Recency. — The recently experienced feeling is readily repeated. The mourning band reminds us that we must not speak of death, although when we are all some time removed from it, we joke about it freely. "I know how to sympathize with you," we say to one found in the evil plight which we have just passed through. The channels are open for the former feeling, so that some measure of it, sufficient for sympathy, is quickly reinstated.

Influence of affective experience on the body. — We have noted above the general effect of bodily conditions on the feelings. Now, what influence has feeling on the body?

1. *Feeling sets the body to seek or shun.* This may not always mean agitated action. The dog dozing off in the sunshine, the lady who, though in her parlor, is not "at home" to callers, the listener lost in the opera, all are seeking or shunning. The organism is bent on getting more of a given kind of experience or getting less of it. (1) Sensations, that is, perception or idea, (2) feeling, (3) behavior; (1 *a*) more perceptions or ideas resulting, (2 *a*) more feelings, (3 *a*) more behavior: this is the unending spiral, enlarging as experience increases.

2. *Mild, agreeable feelings generally lead to the building up of the body.* "Mild" means calming and relaxing. (Recall the sense-feelings listed above.) We are compelled

to say " generally," for what with nature's rough method of inducing her animals to seek or shun, and what with pathological human feelings, there may be many exceptions. But it is true that mild and agreeable feelings tend to keep the body on a " peace footing " (see below), in a prosperous and constructive condition. Thus the welcome sight, or even thought, of food, may start the saliva and the gastric juice and keep them flowing for twenty minutes.

3. *All intense and all disagreeable feelings consume energy and set the body for action.* In the great struggle for existence, nature has used the more intense feelings, such as fear and rage, to set off the most violent seeking or shunning, as in the attack to kill or the flight for safety. All the constructive processes are at once inhibited or turned in the direction of immediate action. Digestion is stopped both as to secretion and movement of organs. The sugar stored in the liver is poured into the blood, the heart speeds up and strengthens its beat, the lungs quicken their action, the muscles respond more readily to stimuli, blood surges to the brain. The body is on a war basis, spending its stored energy.

Professor Cannon likens the body, in peace and in stress, to a nation in peace and in war. In time of peace, both the body and the nation are built up and reserve forces accumulated; but in time of stress or war, all constructive activity must cease and all available energy must be poured out lavishly, perhaps even wastefully. " One who permits fears, worries, and anxieties to disturb the digestive processes when there is nothing to be done, is evidently allowing the body to go on to what we may regard as a ' war

footing' when there is no 'war' to be waged, no fighting or struggle to be engaged in." [1]

The flutter and tremor that accompany all this, constitute a considerable part of the affective complex.

General course of affective experience. — As we discovered (in the last chapter) how thought goes on, by analyzing a simple case of it, so let us try to learn the general course of affective experience by studying a naïve sample.

A baby sees a cat. Being naturally curious about living, moving creatures, he finds the sight agreeable. There is aroused in him a tendency to seek for more of this cat-experience. He creeps up and seizes the animal by the tail. The cat, finding it avails nothing to cling to the rug and pull, turns and scratches. Hereupon the baby cries and relaxes his grip on the tail. Pussy escapes. Next day, the child, having a cup of milk, hears the cat mew at the door, has an idea of the animal coming, sets down the cup and makes away. The cat eats the milk.

In both cases, whether we look from the standpoint of the cat or of the child, three features stand out:

1. An inciting perception or idea, agreeable or disagreeable.
2. A tendency to seek or shun.
3. Success or failure in seeking or shunning.

Romance and reflection. — This little story is really a romance, for the essence of romance lies in following feeling blindly, be the outcome what it will. The end is quite usually tragedy — or comedy. If there is luck it is "dumb luck." All babies and many grown people are romantic.

[1] Walter B. Cannon, *Bodily Changes in Pain, Hunger, Fear, and Rage*, p. 269.

There is much the same difference between a naïve and a reflective feeler as there is between a naïve and a reflective thinker. Here, again, the large steps in the process are the same, but the more stable and well-ordered mind takes each step less precipitately, with more circumspection.

In the first place, the earnest soul does not go gawking and meandering through the world, waiting for inciting perceptions and ideas, but is seeking something, pursuing a purpose. Secondly, the tendency to seek or shun is held in leash until associated ideas are aroused, pro and con, and the probable outcome pictured. And thirdly, while the short-span mind may seem to succeed better in a short run, the long-span mind seeks and shuns more successfully in the long run.

All feeling has to do with seeking or shunning. — Man is a born striver. When he no longer wants anything, it is time for him to die. In fact, he shuns death and other disagreeables for the very purpose of winning what he wants.

All our music, painting, sculpture, architecture, literature, pleases and inspires us by its presentation, or suggestion, of successful seeking or shunning. We hang pictures of good cheer on the walls of the dining room, where the tendency to eat is gratified. No one would hang in such a place the picture of a man perishing by drowning. And if we do sometimes contemplate the tragedy of the unsuccessful, as in the Laocoön group or the death of a hero, it is either because the characters are so far removed from us that we cease to sympathize and struggle *with* them, and so come to enjoy them somewhat as we enjoy eating an oyster; or because the picture of the

present partial defeat suggests a larger and more lasting victory.

Kinds of affective complex. — Four kinds of affective complex are quite commonly distinguished, *feeling*, *emotion*, *mood*, and *sentiment*.

A feeling is a like or dislike of moderate strength and complexity. A perception or an idea may start so much affection and sense-feeling as to be overflowed by it. Your pupils are studying a flag, either in its presence or from memory (that is, as perception or as idea), the number and arrangement of the stars and the stripes, the colors, and so on. Here is a sense complex. But now all repeat:

> "When freedom, from her mountain height,
> Unfurled her standard to the air,
> She tore the azure robe of night,
> And set the stars of glory there."

The arithmetic and geometry of the flag are forgotten. The perception or the idea has started a flow of affection. A feeling has come.

Feeling and emotion are alike, and we cannot say just where one passes into the other. As a mountain is a great hill, so an emotion is a strong and complex feeling. Further, the emotion arouses a much stronger tendency to seek or avoid. Complete the recital of the poem, follow it with a patriotic speech and a flag raising, and all may be

> "Ready to fight, ready to die,
> For Fatherland."

Mood is affective mental set; that is, mental set considered with regard to affection rather than sensation. It may come as the after-effect of an emotion, as when one

who had been angry feels like "slamming" something for a time; or may result from the summation of sundry agreeable or disagreeable little stimuli, as when a few compliments, coming in succession, charm one into his best mood for a whole day.

Sentiment is a kind of feeling based on affective brain set. It is the most lasting of the affective complexes, being, like moods, long-lived as compared with feelings and emotions, which are usually of shorter duration. If emotions are the high and foaming waves on the mental sea, sentiments are its slower-moving but powerful tides. Usually a sentiment results from long experience with the object of it. From long experience with the home and the saloon, we may form an attachment for one and an aversion toward the other. A sentiment is not so much a continuous thrill of feeling as a constant possibility of feeling. You love your home, but you never feel this love continuously throughout every hour of the day.

Since these long-lived attachments and aversions have so much to do with shaping our fate, it is worth while to note that they are of two kinds, naïve and reflective. The naïve sentiment grows from long associations, but without serious reflection. An example is the patriotism of the peasant who loves his country simply because he happened to be born and brought up in it, or a swain's love for his neighbor's daughter because of propinquity merely. The reflective sentiment is thoughtful, exemplified in rational attachment to country, and the satisfaction of head as well as heart in choosing a mate.

Control of feeling. — To control feeling, we must control the amount and the direction of consciousness. Much

can be accomplished by securing favorable bodily conditions. Those who are given to passion can sometimes avoid it by working off excess energy in exercise.

From our findings, there appear to be three points whereat we can apply control-power more directly: (1) the inciting sensations, (2) the tendency to seek or shun, and (3) the success or failure of the seeking or shunning.

(1) In the case of children and weak adults, those incitements to which we do not wish them to respond, as candy, alcohol, or lewd pictures, must not be perceived. And if we can keep the mind fully occupied with good, even *ideas* of an objectionable kind can not enter.

(2) As one develops, he is no longer subject to whatever happens to appear in the environment. Power of control, and so the kingdom of happiness, lies within: by encouraging or suppressing the tendency to seek or to avoid, the feeling can be strangled at birth or fostered into maturity.

(3) All our rewards and punishments are designed to make one line of conduct successful and another unsuccessful, and so to render the *idea* of such conduct disagreeable in the future, to make it arouse a tendency to avoid. A school in which a pupil can break rules continuously and successfully, should give a diploma for immorality.

What would perfect feeling require? — We wish to succeed in our surroundings. Success depends on how we act. And how we act depends on how we feel toward the persons, objects, and events in our environment. What each of us should try to do, then, is to make clear his highest purpose in life, determine what things are necessary to its achievement, and cultivate attachments for these things.

But perhaps there is an even larger view. In the last

chapter, it was stated that the perfect thinker would have an image for everything in the universe and would set his mind on the whole of things. Now, the noblest souls among us seem to set their *hearts* on the whole of things, their supreme seeking includes the race, humanity, the world, what one may call the will of the universe. The great trouble with our feelings is their pettiness. We must stop worrying over the weeds in our garden and look away to the eternal hills, contemplate the good, the beautiful, the true.

SUGGESTED CLASS EXERCISES

1. Each member of the class may attend a moving-picture show and note especially (*a*) what in the picture aroused his feelings most, (*b*) how these feelings tended to express themselves, (*c*) expressions of feeling observed in the audience, (*d*) means used by the actors to suggest or express feeling, and (*e*) the successful or unsuccessful seeking or avoiding found in the plot.

Report and discussion.

2. The instructor may read passages from emotional literature of various kinds, the pathetic, funny, joyous, etc.

Introspection and discussion.

3. A skillful actor (perhaps a member of the class) may express various emotions by attitude and gesture, with or without words.

Observation, introspection, and discussion.

4. Pictures large enough to be seen well from any point in the classroom may be compared in pairs as the colors were in the class experiment at the close of Chapter VI. The subjects may include landscapes, live animals, human faces and figures, and various scenes from human life. (Large copies of celebrated pictures may be obtained cheaply from the Perry Pictures Company, Malden, Mass.)

Pictures may be judged on the strength of their appeal to the feelings. Try to generalize with regard to the most popular and the least popular pictures.

FOR FURTHER STUDY

1. Study the picture in Fig. 32 as you did that at the opening of this chapter. Is there any difference in the effect on you? If so, what causes it?

FIG. 32. — How does it affect you? Why?

2. Collect a list of words referring to the feelings.

3. Why do students, intent on getting an education, appear happy when a teacher fails to appear at class hour?

4. Why is the reading of a play commonly less pleasurable than seeing it played?

5. What should be one's affective condition at the beginning of a meal? Why?

6. The American Indian is almost certainly of Mongolian strain. Why are people commonly proud of Indian blood, whereas they probably would be slow to acknowledge Mongolian descent?

7. One is actually stronger when he is "mad enough to fight." Why is this?

8. Is it wise to cheer athletes during a contest? Why? Would it be wise to cheer a group of thinkers in the midst of their cogitations?

Would you advise the silent waving of a handkerchief to spur them on? What does this show?

9. Write the details of some emotional experience of yours. *Keep the emphasis on your affections and sensations*, making the objective circumstances as incidental as may be. Describe (1) the inciting sensations, (2) the tendency to seek or shun, and (3) the mental state resulting from success or failure.

10. Test the doctrine of seeking and shunning by applying it to pictures, poems, religions, wars, etc.

11. Can you study well when you have just experienced a strong emotion? Judging from the facts set forth in this chapter, how would exercise help to "cool you down"? Try it.

12. Draw a cube, showing three faces. Divide it into halves in three ways, left and right, upper and lower, front and back. Give these halves the following names in the same order: agreeable and disagreeable, exciting and calming, straining and relaxing.

Write a three-word description of the general kind of sense-feeling represented by each corner of the cube, as agreeable-exciting-straining. Try to think of an actual situation that would give rise to each kind of sense-feeling.

13. How does an ideal differ from a mere idea?

14. Analyze a prejudice, say the common prejudice against the English, due to youthful study of the Revolutionary War.

15. What is the difference, in terms of feeling, between the optimist and the pessimist?

16. Plan some ways of making a school day begin pleasantly for your pupils.

17. Recall some of the most popular school songs. What makes them popular?

18. Note and report on "Individual differences in the feelings," taking account of the easily angered, the sentimental, etc.

19. Discuss the relation between school discipline and children's feelings.

20. Tell why you have liked or disliked certain schools, teachers, schoolmates, branches of study.

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CHAPTER XIV

EXPRESSING EXPERIENCE: TYPES OF BEHAVIOR

Exercises. — 1. Repeat the exercise at the opening of Chapter IV, and review that chapter.

2. Write an introspective account of "How I learned ——." Choose some skillful act, such as writing, typewriting, swimming, dancing, playing a musical instrument. Tell "how it seemed," what you thought and how you felt (*a*) when you began, (*b*) when you had half learned, and (*c*) when you had mastered the art. What was uppermost in consciousness in each case?

3. If your instructor so directs, begin No. 1 of the Class Exercises at the close of this chapter.

Mind and behavior. — In Chapter I, it was stated that the subject matter of psychology consists of the thoughts and feelings which lie between what the world does to us, and what we do to the world, between stimuli and reactions. Now, we have studied these "thoughts and feelings," all the elements and complexes which, so far as known, ever enter into the make-up of mind. Having learned how the brain gets its experience, records and reproduces it, analyzes and synthesizes it, we must now consider how all this experience is related to behavior.

An outline of mental elements and complexes.[1] — Let us first take a bird's-eye review of experience by completing the outline begun in Chapter VI.

[1] It is advisable to memorize this outline and the one that follows (Fig. 33).

MIND

Elements	*Complexes*
1. Sensations	1. Sense complexes
a. Impressions	*a.* Perceptions
b. Images	*b.* Ideas associated in the form of: (1) Memory (2) Imagination (3) Thought
2. Affections	2. Affective complexes *a.* Feeling *b.* Emotion *c.* Mood *d.* Sentiment

An outline showing the relation of consciousness to behavior. — We are at length ready to complete also the outline of behavior which was begun in Chapter IV. We can now analyze the various forms of behavior somewhat more thoroughly.

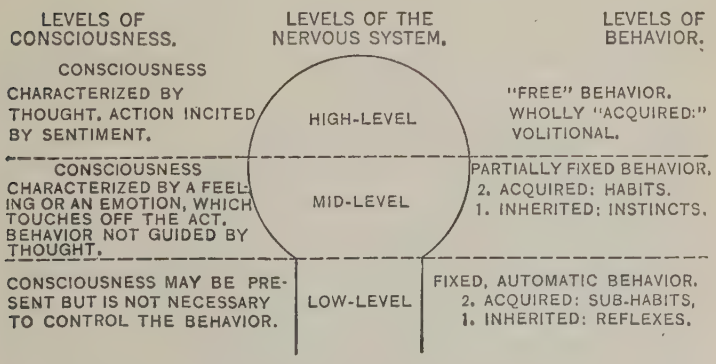
LEVELS OF CONSCIOUSNESS.
LEVELS OF THE NERVOUS SYSTEM.
LEVELS OF BEHAVIOR.
CONSCIOUSNESS CHARACTERIZED BY THOUGHT. ACTION INCITED BY SENTIMENT.
HIGH-LEVEL
"FREE" BEHAVIOR. WHOLLY "ACQUIRED:" VOLITIONAL.
CONSCIOUSNESS CHARACTERIZED BY A FEELING OR AN EMOTION, WHICH TOUCHES OFF THE ACT. BEHAVIOR NOT GUIDED BY THOUGHT.
MID-LEVEL
PARTIALLY FIXED BEHAVIOR. 2. ACQUIRED: HABITS. 1. INHERITED: INSTINCTS.
CONSCIOUSNESS MAY BE PRESENT BUT IS NOT NECESSARY TO CONTROL THE BEHAVIOR.
LOW-LEVEL
FIXED, AUTOMATIC BEHAVIOR. 2. ACQUIRED: SUB-HABITS, 1. INHERITED: REFLEXES.

FIG. 33. — Levels of consciousness, of the nervous system, and of behavior.

The chief facts concerning consciousness and behavior. — Before proceeding to the special study of each kind of behavior, let us consider some of the larger, general features of our outline.

In the first place, observe that low-level behavior is fixed and mechanical, mid-level behavior partially fixed, and high-level behavior not fixed at all. Observe also, in the "consciousness" column, that the levels are marked by *no* (necessary) consciousness, by a *feelingful* consciousness, or by a *thoughtful* consciousness. The lower the level, the less complex the consciousness.

Now appears, more prominently than before, the tremendous function of the feelings, the affective complexes, in the make-up of a personality. Mid-level behavior, our habitual and instinctive acts, is started by a feeling or an emotion; and the background for these is of course a mood. High-level behavior is effected or defeated according to the presence of sentiment, and especially the more rational type of sentiment. Whatever does not affect our feelings, then, will not influence our behavior. But whatever we build into the brain in an affective way will come out as conduct. "Let me write the songs of a nation and I care not who makes its laws." If we would educate for action, we must educate for appreciation.

We find an inherited and an acquired type of both low-level and mid-level behavior, whereas the high-level action is wholly acquired. The only essential difference between the inborn and the acquired type is that the inherited form is more thoroughly fixed, less easily changed.

Finally, all these sharp divisions which we have made for the sake of clearness, fade away in actual conduct: the

nervous system has no partitions in it, and the different forms of behavior shade into each other gradually. Even the ideas of "inherited" and "acquired," "fixed" and "free," can not be marked off from each other by a hair line.

Having glanced at these outstanding features, let us look at each kind of behavior in more detail.

Fixed, automatic behavior. — "Automatic" means self-operating: low-level behavior "works itself" without the necessity of conscious control. "Fixed" means that it can not be changed, or at least, not without great effort, if at all. Low-level behavior is almost as mechanical as the movements of a penny-in-the-slot machine.

The reflex. — Inherited low-level behavior is called reflex. Examples are the movements of heart, lungs (in ordinary breathing), stomach and intestines, the change in size of the pupil of the eye under the influence of light, sneezing, the sucking and crying of the new-born child, and most of the simpler movements that express anger. A dog, after its cerebral hemispheres have been removed, "by growling and biting when handled, has the appearance of being enraged; the decerebrate cat, when vigorously stimulated, retracts its lips and tongue, stares with dilated pupils, snarls and snaps its jaws." [1]

It was not found possible to elicit from the animals any expression of joy or affection or fear or sexual feeling. Much of the emotion of anger probably boils up from these reflexes, as the sneeze-feeling comes from the sneeze reflex. Anger seems to be the lowest of the emotions so far as the nervous system is concerned, even if not morally.

[1] Walter B. Cannon, *Bodily Changes in Pain, Hunger, Fear, and Rage.*

With reflexes, the teacher has little to do except to teach her pupils how to avoid the conditions, such as worry and extreme fatigue, which interfere with the reflex processes of digestion and circulation.

The sub-habit. — There is in common use no simple term by which to designate acquired low-level behavior. Let us use for this purpose the name *sub-habit,* which will constantly remind us that such behavior is simply habit reduced by practice to the non-conscious, mechanical grade.

Repetition reduces resistance, and in the sub-habit has reduced it to the limit. Your fingers are almost as much a part of the mechanism as they are of you when you press the familiar keys of your long-practiced instrument. A fatigued soldier may ride, or even march, while sleeping. A shoemaker, subject to fits of unconsciousness, has been known to continue the boring movement in the midst of which the fit seized him, and twist the awl into his fingers.[1]

Notice that, although the low level of the nervous system can not take on the behavior of a higher level, the upper centers may by practice learn to respond sub-habitually. Carpenter gives a case of a tipsy woman playing the piano. She dozed off, but played perfectly until made to stop. She could be started again, almost as if she were a mechanical player, by placing her hands on the keys. She would then begin a new piece, go to sleep, and play on.[2]

Border-line behavior. — Let us remember again that there are no sharp separations between adjacent types of behavior. The mid-level is marked by consciousness, the low-level by none; but between the two are samples ac-

[1] William B. Carpenter, *Principles of Mental Physiology,* p. 75.
[2] *Op. cit.,* p. xix.

companied by unavoidable but apparently useless consciousness — useless, that is, so far as concerns the control of the act. Such are yawning, sneezing, starting at a bright light or a sudden sound, vomiting because of a sickening taste or smell, gasping when we wade in for our first swim, and the like. In these we find our introduction to instinct.

Samples of instinctive behavior. — Examples of instinct abound, especially among the lower animals. Your dog or cat, or the two together, will give you an exhibition of it any day.

Birds and seals migrate thousands of miles at the call of the season, returning, in some cases at least, to the very spot from which they started. Ants and bees live in colonies where each plays his part with much more system and much less " red tape " than are found in most human communities. Some of the ants are fed by slaves, without whose services they would die of starvation.

The most significant facts about instinct. — Evidently, we are studying a very complex type of behavior, inexhaustible in its details. We shall get the clearest view of it by selecting a few salient features. Observe that both these terms, *habit* and *instinct*, are used variously, to refer (1) to the behavior only, or (2) to the consciousness accompanying such behavior, or (3) to both the consciousness and the behavior considered together. The third is the complete meaning.

1. What is instinct? Instinct is inherited mid-level behavior; that is, it is partially fixed, but can be changed with effort, especially in human beings; its nervous control is in the lower brain centers; and it is presided over

by a feelingful rather than thoughtful consciousness. It differs from habit in being inherited.

2. Instinct is nature's great life preserver. If any animal species is to live for long in the land, its members must not only (1) save themselves but also (2) serve the species, especially in the way of begetting and rearing offspring. Examine any instinct and you find all its energy urging in one of these directions.

By tracing out the general trend of these two fundamental instincts, that for food-getting and that for mating, we discover several minor, supplementary instincts. The *competitive* and *fighting* instincts impel to rivalry; the *fear-and-flight* instinct preserves when one is overwhelmed by odds; the successful must usually hang together, hence the *gregarious* instinct; and they must follow their leaders in fight or flight, hence the instinct of *imitation;* the *inquisitive, exploring* instinct keeps creatures in touch with their environment; the *collecting* and *building* instincts (witness chipmunk and beaver) provide food and shelter; the *parental* instinct insures the care of the helpless young; finally, the *play* instinct prepares these young for adult activity: the Indian boy attacks a nest of hornets to school him for war.

They who lack the chief instincts of their species perish without progeny: their kind is lost.

3. Instinctive behavior is the outward and visible expression of an inner nervous structure. We think it nothing strange when we push a button or a lever and start a machine: the machine is " ready made " to respond to just that form of stimulus. So, nature has wired us all up — or nerved us up, with graded resistance and preferred paths,

ready for action when the right stimulus starts us. Not much repetition is needed to reduce resistance, for there is little resistance to be reduced. This enables us to understand why an animal, blindly following instinct, nevertheless makes every move count as if toward a clearly conceived purpose. Yet a beaver, kept in a dry house, will construct a dam and a home, of furniture, broomsticks, paper, and so on, as seriously as if in his native waters. Birds, seized by the migratory instinct, sometimes make off and leave their young to starve in the nest. The instinctive nerve-machine has been started at the wrong time.

Now we can also see clearly why such behavior need not be learned — though of course it may be improved with practice. Bird or beaver, reared in exile, with no possible memory of the parental abode, nevertheless builds, when the neurones have ripened to the proper point, the typical nest or dam.

4. Instinct generates emotion. In the last chapter, it was stated that nature has cast a glow of strong feeling about those acts most necessary to existence. We now find that these preservative acts are instinctive. Putting these two statements together, it appears that instincts are emotional and emotions are instinctive. To say that one is instinctive and to say he is emotional come very near to saying the same thing twice. Both statements can be made of all beasts, and of many human beings. As men and women are expected to rule their instincts by reason, we can readily see why prigs pride themselves on showing no emotion, and why cultured people express it in a cultivated way. However, emotion may accompany rational action also.

To the teacher, this connection of instinct and emotion is important because it shows him how to arouse the *interest* he is so anxious to secure. In physical culture, for example, free, instinctive play is crowding out much of the old formal gymnastics. The play is more interesting, and so, for the most part, more beneficial.

5. Instinct is educable, especially in man. The lower the creature, the more that creature can do when very young, and the less it can learn afterward. Young animals hatched from eggs are, in general, more completely outfitted with instincts, and more fixedly subject to them, than those born of mammals. The human organism has been compared to an instrument with keys, such that a variety of music, anything within its range, can be played at the will of its operator; whereas an insect is like a barrel-organ which plays with invariable precision its little stock of tunes, but can play nothing else. Yet instinct, even in an animal so low as the fish, can be trained, almost repressed. A pike, foiled by striking its nose against a glass partition whenever it attempts to capture small fish, will in time swim among them harmlessly, the partition having been removed. Man's many instincts are comparatively loose, general tendencies, like the tendency of a vine to climb upward, capable of training along many special lines.

Nature of habit. — Habit is *acquired* mid-level behavior. Instinct is inherited. It is in this point chiefly that they differ. Instinct comes to us ready-made from our ancestors. Habit is, or may be, made to order by each one of us.

In general, then, we may think of a habit as a kind of special branch running off from the trunk line of some in-

stinct. In fact, it is often hard to tell where instinct ends and habit begins. It is instinctive to eat, habitual to eat three times a day; instinctive to play, but habitual to choose a favorite game; instinctive to use the vocal organs, habitual to speak the mother tongue; instinctive to take what we want, habitual to take possession of it politely. It is no wonder, then, that in time of great stress, habit-paths are closed and the old, crude course of the instinct forced wide open: the instinctively excited individual may eat anything at any time, engage in rude horse play, yell instead of speaking articulately, or grab what he can get, neighbors or no neighbors.

All the larger truths we have discovered about instinct should be correspondingly true of habit. Instinct is nature's life preserver; so are habits, *if they are good ones*, but the bad habits we form are life destroyers. Both instinct and habit have corresponding paths in the nervous system. Instinct is marked by emotions; habit, as a rule, by feelings. Both are partially fixed, and so, in large measure, educable.

Prevalence and persistence of habit. — If we flatter ourselves that all our acts are well thought out, it will be enlightening to list all we do for a day and check off the habitual behavior. We are, as James says, "walking bundles of habit." He asserts that at least ninety-nine hundredths of all we do from morning till night, even including our acts of politeness and most of our speech, are so deeply habitual as to be almost reflex in nature.[1]

And although habit is, in general, but partially fixed, the range of fixity runs all the way from the random looseness

[1] See *Talks to Teachers*, by William James, p. 65.

of what we may call occasional habits to those deeply ingrained performances which have become "second nature," or as the Duke of Wellington extravagantly said, "ten times nature." One poor victim of the drink habit advertised the fact, in part as follows: "I am a person of intemperate habits and have no control of myself. I shall positively prosecute all persons who will furnish me with drink." He called on his friends to stand by him, and to aid in the prosecutions. But a year or two later, he despaired of the fight and committed suicide.

Habits are forming ceaselessly. — The nervous system is a recording angel with no power of forgiveness, save as we work out our own salvation. "Every act of the soul leaves as its enduring result an increased power to act, and a tendency to act again in like manner." [1]

On this point, the words of James have become classic. "We are spinning our own fates, good or evil, and never to be undone. Every smallest stroke of virtue or of vice leaves its never-so-little scar. The drunken Rip Van Winkle, in Jefferson's play, excuses himself for every fresh dereliction by saying, 'I won't count this time!' Well, he may not count it, and a kind Heaven may not count it; but it is being counted none the less. Down among his nerve-cells and fibers the molecules are counting it, registering and storing it up to be used against him when the next temptation comes. Nothing we ever do is, in strict scientific literalness, wiped out." [2]

The teaching of habit. — As the higher brain centers control the lower, or habit centers in one's nervous system,

[1] Emerson E. White, *School Management*, p. 106.

[2] *Talks to Teachers*, p. 77.

so the teacher's high-level neurones must in some measure control the pupil's habit level of activity until his own superior centers develop. To some extent the teacher must determine which habits are good to form and which bad, and must help to break off the bad or guard against them, and build up the good. How can this be done?

To begin with, no sensible person will take and pay for anything unless he is convinced that it is worth the price to him. The teacher can act as salesman, can convince the pupil that he will get full value for his time and effort, in speed, skill, accuracy, ease, and self-confidence if the habit is one of mechanical manipulation; or if it is of a moral nature, in self-control, self-respect, social standing, personal efficiency and progress toward some greater goal.

Either in this educational selling talk or following it, we must bring out the essential features of the new habit in a way that is *clear* and *striking*. There is nothing better for the pupil; for what is well seen and loved is already half owned. Acquisition is most quick and active when the pupil "catches on," conceives a clear idea of the set of the skate, the twist of the wrist, the swing of the saw, or the mold of the mind necessary to success. If the performance is a very difficult one, or by its complexity demands diffused attention, we shall need to analyze it and master a part only at each effort.

Further, the teacher can be a kind of detached conscience, starting the learner off promptly at practice time and coaching him according to the conditions of the day (weather, health, mental condition, etc.). Sometimes he will need a bracer in the form of good cheer or praise of his accomplishments; and always, when he has "struck it

right," he will profit by the exhortation, " Think how you did that. Do it again. Don't let it get away from you."

Finally, it is no small service to keep the pupil's attention off his own mental state and other matters which should slide into the background of his mind, and to start him full tilt at the *lesson itself*, set wholly on turning out a piece of well-done work.

Value of the various types of behavior. — As compared with free, high-level behavior, that which is partially or completely fixed has two advantages, its *immediateness* and its *thoughtlessness*.

The situations which are best met by habit, instinct, sub-habit, and reflex, are largely those which require prompt response, as pulling away from a hot fire (reflex), pulling one's foot out of the way when something is dropped (sub-habit), running out of danger (instinct), doing the fire drill when the alarm sounds (habit). The nervous grooves are well cut for such cases: they have to be; for thought requires time, and delay would mean damage, or even death.

And secondly, having so much behavior stereotyped leaves consciousness free to attend to new business. Seated in the upper neurones, it can by a single command set into activity hundreds of subordinate nerve cells, as a commander-in-chief can keep an army moving, himself at ease and considering how the army shall move next.

Deep thought is slow and ponderous. Thoughtful, volitional behavior is nature's way of meeting new climactic situations which require our most carefully determined reaction. Of such a case, we are likely to feel that " this is so sudden," and to seek time to think it over.

High-level behavior. — Man's nervous system has a third and higher story as compared with that of lower animals. This upper structure has no such strongly marked inborn paths as has the lower, but lies chaste and pathless, ready to be marked, grooved, *educated* by the environment. These high-arching neurones are the abode of our loftiest thoughts and finest sentiments, controllers of our most complex, long-span behavior.

Yet there is nothing altogether new and different in this region of reason and "free will." Man is sometimes said to have reason and will in place of animal instinct and impulse;[1] but it would be truer to say that, in addition to the animal equipment of instincts, he has also the instinct of sagacity, a natural outgrowth from competing and contradictory instincts.

Take an example. A cat wants food that is guarded by a dog; the eating instinct and the fear instinct clash. She hesitates, advances, recedes, "makes up her mind" — that is, these opposing instincts make it up for her as they discharge their force, until she finally dashes one way or the other.

Now, the human will works similarly, but of course much more complexly. The number and power of the mental forces in the conflict vary greatly, but might makes right among nerve currents as truly as between opposing currents of water. The more animal-like one is, the more is he determined by objects and events lying concretely

[1] An impulse is a fragmentary bit of instinct (or habit). By some, it is regarded as the original form of behavior, from which all other forms developed. See especially Titchener's account of it in *A Text-Book of Psychology*, pp. 450 ff.

in his immediate presence. In the " higher " individual, there are stored stimuli (so to speak) in the form of images, and the battle takes place in the brain, perhaps without any objective, dog-and-cat situation to energize it.

Reason bears somewhat the same relation to the instincts that the federal government bears to the old colonial and state governments in United States history. These state governments still exist, and the states (that is, the people) furnish the power of the nation, give it impetus in its undertakings. But there is a unity not found before, resulting from the leveling and the common limitation of the interacting forces. A volition, an act of will, if it is anything more than instinctive stubbornness, is a kind of democratic vote of all the constituents of consciousness: the power of the minority is largely inhibited; the might of the majority goes into action.

CLASS EXERCISES

1. In order to study the forming (or breaking) of a habit, choose one or more such as the following, for practice: ventilating your room, breathing deeply, exercising an hour a day, eating slowly, standing or sitting properly, keeping your temper, reciting in good voice, enunciating clearly and vigorously, eliminating all eating between meals, going to sleep promptly. Other habits may be suggested or sanctioned by the instructor. Those are best which offer regular occasion for at least daily exercise.

Keep a record of (*a*) opportunities, (*b*) successes, (*c*) failures; also, an introspective record of most significant facts, including helpful devices.

The record for the class may be computed. Perhaps class discussion will reveal rules for habit forming.

2. Thoughtful determination of conduct. Let the instructor present the following, or an equivalent selection.

"A settlement was once besieged by a large body of Indians because the chief thought that one of the white men had done him an injury, though he really had not done so. The chief sent word to the captain of the village that if the man was given up to him he would go away, but if not he would burn the village and kill the people. The captain and the people knew that if the Indians attacked them they would be very likely to capture the settlement, and at least, would kill a good many. They also knew that their fellow citizen was innocent and that to give him up meant torture and death for him.

"What was the right thing for the captain of the village to do and why?

"What would you have done if you had been captain?"[1]

Introspection and class discussion.

3. Plan an experiment to discover how quickly a given group of pupils can learn a simple habit (act of skill). Get the average result, and also the kind and amount of individual variations found in the learning.

Suggestions: Can you make use of the maze at the end of Chapter II or the figure at the end of Chapter IV? Should quickness of learning be measured by time, or by the number of repetitions necessary before the act can be performed without hesitation? Is it better to present the piece of learning without comment, or explain it as you would in teaching it to a class? How can we standardize the experiment so others can perform it after us if they wish to?

FOR FURTHER STUDY

1. Have you found anything in this chapter which helps you to explain how one can walk in his sleep? If so, what?

2. What is the function of the higher brain centers in learning any new act? What have they to do with the act when it has been well learned?

[1] Healy and Fernald, Psychological Monographs, Vol. XIII, No. 2 (*Tests for Practical Mental Classification*), p. 47.

3. Make a list of the chief instincts (such as that of play) which could be depended on to arouse interest in school work of any kind.

4. Analyze out the instinctive situations and activities found in our most common games. Can you imagine a good game with no competition in it?

5. List all the more common emotions. See what relation you can discover between them and instinctive activities.

6. Are instincts good or bad? Or partly good and partly bad? Or neither good nor bad? Give reasons.

7. Should instincts be repressed or rationalized (that is, permitted to express themselves in the proper time and way)? Can you think of any which have become so useless that they should, if possible, be totally outrooted?

8. Why can not men build houses without learning the trade, as beavers build dams? Can you see any evidence of a constructive instinct in children?

9. What happens if one can not practice his old habit at the old time — say if dinner is not ready promptly? Why is this?

10. See if you can justify nature's wisdom in placing certain reflexes beyond our control.

11. When we try consciously to guide a sub-habit, it often fails to work well. Why is this? Illustrate.

12. Make a list of situations which would require considerable thought before action. Show why mid-level behavior would not suffice.

13. Report cases of instinct and habit which you have observed among lower animals.

14. Have you ever noticed apparent thoughtfulness in the behavior of animals? of children? What is your explanation?

15. How do you explain the conflict between the "higher" and the "lower" nature?

16. Look up the story of the speckled axe in Franklin's *Autobiography*. What is the psychology of the situation?

17. Discuss the naïve and the reflective formation of habits. Which should prevail in a purposeful life?

18. If a trait appears late in life, is it therefore not inherited? Give proof.

19. Describe the condition and probable behavior of one without instincts or habits.

20. Why can one cough, but not sneeze, voluntarily?

21. Says Spalding: "One day, after fondling my dog, I put my hand into a basket containing four blind kittens three days old. The smell that my hand carried with it set them puffing and spitting in a most comical fashion." Explain.

22. Show the importance of teaching pupils to think, as a means of influencing their high-level behavior.

23. Describe the steps you would take in teaching such a habit as pen-holding.

24. Which is easier, to teach children their games or their lessons? Why?

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CHAPTER XV

INDIVIDUALITY AND INDIVIDUAL DIFFERENCES

Exercise. — Make a list of all the questions you would care to ask about a stranger in order to learn at least the main features of his personality.

Suggestions: What points would you emphasize in setting forth the inner nature of one of your close friends? What would one need to know of Emerson in order to understand him as a person? Of Poe? Of General Grant? Examine one or more biographies and find what psychological points stand out most prominently.

Try to convert your list of questions into an analytic outline of personality.

If we made a list of the traits in which people differ, it would include all the traits there are. It is only when we observe them superficially that they all look alike to us. As Thorndike says,[1] if we measured men's heights with a scale which had nothing less than yards marked on it, nearly every one would be called two yards high. But put inches on the scale and there appear great differences as expressed in this finer unit. The same is true of every other trait.

Our first effort, then, should be to get a general idea of personality, as we would get a general view of horse nature or dog nature, leaving minor differences out of the account. But if we expect ever to deal successfully with *individuals*, to manage children as a good organizer and leader manages men, we must study how each varies from the common type, and what special treatment is necessary.

[1] See E. L. Thorndike's *Individuality*.

Let us look at the mind as a whole. — Psychology is the science of personality — mental personality. Consequently, when we have analyzed mind into parts, we are not satisfied merely to go on contemplating the parts. You learn much about your bicycle by taking it to pieces; but pieces are not a bicycle unless they go together and run together. He who would thoroughly know either a machine or a mind must watch it as it runs. In this chapter, then, we shall study minds as going-machines, as mental persons, and discover what we can to help us understand and appreciate them, compare them with each other, and estimate them at their true value as working forces in the world.

Self is the key to other selves. — "Know thyself" was inscribed over the doors of certain Greek temples. It is written also over the entrance way to psychology. No one who is not well acquainted with himself can ever sympathetically know another.

One who was familiar with the gold-bearing mountains of California noticed that the mountains of Australia had the same appearance. He reasoned by *analogy* that these latter mountains were probably gold-bearing, with the result that gold was discovered in Australia.

We can not see our neighbor's soul, any more than a prospector can look through a mountain and see the hidden gold: we know minds by analogy. Consider a case: your friend receives a letter, reads it, rolls a sparkling eye, smiles expansively. You understand that, for you have been through something similar. We can state the analogy as a proportion:

$$\left.\begin{matrix}\text{My body}\\ \text{and behavior}\end{matrix}\right\} : \left\{\begin{matrix}\text{my con-}\\ \text{sciousness}\end{matrix}\right. :: \left\{\begin{matrix}\text{my friend's body}\\ \text{and behavior}\end{matrix}\right\} : X$$

Solving the proportion, X equals "a consciousness as much like mine as my friend's body and behavior are like mine."

But if your friend acts strangely, that is, as you have never acted, you fail to understand him. The thoroughly vicious can not believe any one is virtuous; the politician does not know a real statesman when he sees one, but looks for a little deeper game than usual. We are often told not to judge others by ourselves: but those who give this advice could not heed it constantly if they tried.

It follows (though we may not like to admit it) that no one can thoroughly understand a personality greater, or otherwise very different from, his own. The master may know the dog, but not the dog the master. Only another Lincoln can know Lincoln. To appreciate the great is to prove yourself great.

Individual differences. — The experienced teacher does not need to be told that children differ in learning power or power of self-control. She can easily appreciate Thorndike's statement that among a thousand ten-year-olds taken at random, we shall find some four times as strong as others in a given trait, such as honesty, energy, industry, sympathy, or ability to learn arithmetic. Investigation shows that among children of the same age and substantially the same advantages both as to home and school, some can do six times as much as others in the same time, or do the same amount of work with only one tenth the number of errors.[1]

As we can not here consider all the trait-differences found among persons, let us observe some of the larger and more important ones.

[1] E. L. Thorndike, *op. cit.*

Short-span and long-span minds. — Perhaps the one best measure of a mind is the distance it reaches effectively into the future. Here, all lesser minds leave off — cats, infants, and fools see no to-morrow ahead of them — and the greater mind, with its vision, begins. Things distant in *space* may never come to trouble us; but *time flies*, and the future always flies our way. We reveal ourselves by our degree of readiness for it when it arrives.

The worthless tramp looks only from meal to meal. Business men tell us that ninety-eight per cent of the people of the United States are dependent on the daily wage, and the majority of these would soon be thrown into dire distress if the wages stopped. Nor is this because of necessity; it is because of our short-span financial bias. It is no wonder that the few who have long-span money-minds can gather gold with ease. Greatest of all are the reformers and saviors of their people, whose deep eyes see centuries ahead.

Purposeful and *purposeless*, then, mark the most meaningful difference we can discover among minds. It is the difference between striving after a distant ideal, and being pushed ahead from the rear by compelling circumstances.

"A man's conduct naturally shapes itself according to the ideas in his mind, and nothing contributes more to success in life than having a high ideal and keeping it constantly in view. Where such is the case one can hardly fail in attaining it." [1]

The in-minded and the out-minded. — The in-minded are they who feel greater faith in their own states of mind as a guide to successful living, than they do in the

[1] David Kay, *Memory*, etc., p. 213.

objective world. The out-minded regard the environment as a great superior, to whose ways they must submit and adapt themselves.

Two peoples, the Hindus and the English, throw up well the contrast between the in-minded and the out-minded. The Hindu lives in the clouds of mysticism, cultivating the kingdom of his mind. It is easier for him to deny the facts of the external world, or even to believe there is no external world at all, than to give up the belief that meditating on things mental, centering mind on mind, will make him master of his fate, superior to all circumstances.

Compare the English mind as described by Emerson.[1] "They have a supreme eye to facts, and theirs is a logic that brings salt to soup, hammer to nail, oar to boat, . . . following the sequence of nature. . . . Their mind is not dazzled by its own means, but locked and bolted to results. . . . They are impious in their skepticism of a theory, but kiss the dust before a fact. They are not to be led by a phrase, they want a working plan, a working machine, a working constitution, and will sit out the trial, and abide by the issue, and reject all preconceived theories."

The English govern the Hindus.

The great fault of the in-minded is that they take themselves too seriously. They may even believe that their thoughts control the weather, or that they could move mountains if only they could conjure up enough faith, or that they have a divine right to rule over others. And they are often as sensitive and important in their bearing as if they were guarding, in their personalities, the compass that steers the world.

[1] *English Traits*, Essay on "Ability."

In-mindedness is characteristic of children, and of the childhood of the race. As we have learned that the earth is not central in the universe, so we must learn that self is not central, either. With the maturing years, man and most men tend to become more out-minded.

The knowers, the feelers, and the willers. — In popular psychology, the mind is divided into three parts, Knowing, Feeling, and Willing. While it is rather crude to map the mind as one would a country, this old division has much practical value.

" Knowing " consists of sensation and all sense-complexes. " Feeling " consists of affection and all affective-complexes. " Willing " is, in general, the going-over of mental states into action, or at least, the settling of the mind into a determination to act. We may speak, then, of the knowers, the feelers, and the doers.

Sensations (1) come into the mind and combine, associate to form sense-complexes (knowing), (2) set up agreeable or disagreeable affections and affective-complexes (feeling), and (3) express themselves in action (willing). Here, then, is a coursing of currents into the nervous system and out again. He who is bent on the in-taking and combining process, is a knower. Such is the man of thought, the scientist, the judge, the philosopher. He who aims chiefly at the out-putting of his mental product so as to move things, get something done, is a willer, doer, man of action, such as the general, the business head, the executive. He who sucks the sweet juice of his sensations, looking for the *enjoyable* rather than the thoughtful or practical, is a feeler. Such are the more emotional musicians, artists, and poets.

The knower seeks the *true;* the feeler seeks the *beautiful;*

the willer, the doer, seeks the *good.* Some balanced natures have all three tendencies in equal strength.

Knowing, feeling, and willing in the world at large. — We find this triple type standing out everywhere — in religion, in literature, in popular speech, in government, in national character. The three great nations of antiquity were the intellectual Greeks, the emotional, intuitive Hebrews, and the strong-willed, executive Romans. In modern government, as if to combine all the virtues of the ancient world, we have a judicial, or intellectual, branch; a legislative, which responds to the feelings of the people; and an executive power.

In popular speech, we find such expressions as " head, heart, and hand." Discourse is divided into Prose, the expression of the intellect, Poetry, the embodiment of feeling, and Oratory, whose aim is to move to action.[1] The three essential qualities of discourse are clearness, elegance, and energy. Heaven is said to be a place of light (intelligence, knowing), love (good feeling), and life (action, will). Even the three Persons of the Trinity, the Father, Son, and Holy Ghost, are thought by some to be the divine Knowing, Feeling, and Willing. So does man project himself into his world, struggling ever toward the true, the beautiful, the good.

Knowing, feeling, and willing as expressed in temperament. — Temperament means general constitution. The idea is a rather vague one, but often helpful for large, practical purposes, as in quickly " sizing up " a pupil.

Psychology gives one classification of temperaments,[2]

[1] See Arnold Tompkins, *The Science of Discourse*, p. 34.

[2] The psychological classification is based on (1) speed of thought and

phrenology another. Probably the phrenological method (substantially that which follows) offers a quicker key to human nature; but the terms of both classifications may well be combined.

The temperaments are three, *mental*, *vital*, *motive*. They are based on bodily build, but express the general mental qualities as well.

The *mental* (knowing) temperament is marked by dominance of the nervous system, usually indicated by a head large in proportion to the body. Typically, the skeleton is small, the muscles are fine but compact, the vegetative systems, especially the digestive, not prominent. But a good thinker is likely to have good breathing capacity. Binet found such capacity to be the one most significant index of general physical excellence, and spoke of it as the "vital index." The face is likely to be refined in feature and mobile in expression. Such a temperament is prone to take to books, and to select a bookish occupation.

The *vital* (feeling) temperament is determined largely by the vegetative systems, the digestive especially. Typically, the body is well rounded by adipose tissue, plump, if not stout. The features are likely to show a similar fullness, and commonly express good humor, the outflow of physiological prosperity. As a rule, those of this tem-

(2) strength of feeling, yielding four temperaments, as shown below. (See Edward Bradford Titchener's *Primer of Psychology*, p. 157, and his *Beginner's Psychology*, p. 226.)

		Thought:	
		Quick	Slow
Feeling:	Strong	*Choleric*	*Melancholic*
	Weak	*Sanguine*	*Phlegmatic*

perament are not fine scholars — the fat pupil seldom stands at the head of his class; but they often shine in social qualities, kindliness, sympathy, and good cheer, and so are successful in dealing with their fellow men, as in business or politics.

The *motive* (willing) temperament takes us back to the adaptive systems, this time the muscular. Commonly, the muscles and bones are large in proportion to other parts of the body, causing angularity and a kind of bold ruggedness which appears in the face also. Here, again, we do not expect profound intellect, especially along abstract lines; but we may look for quick and accurate perceptions, followed by ready action — skill at playing the game, even without the ability to explain it fully. Those of motive temperament are likely to be positively courageous and strong of will, or at least resistive, standing their ground well. They commonly choose occupations that require either muscular activity or mental executiveness.

Often, these temperaments blend, and are named, accordingly, mental-motive, mental-vital, and so on, placing first the name of the temperament which stands out most strikingly. One who combines the qualities of the three main types is said to be of balanced temperament.[1]

What kind of mind, and how much? — The ever important questions, What kind? and How much? here meet us again. Temperament is largely hereditary brain

[1] For a more extended account of temperament, phrenologically considered, see Sizer and Drayton *Heads and Faces, and How to Study Them.* Such books have excellent suggestive power, but are intuitional rather than scientific. Many of their statements must be taken, if at all, with a grain of salt. Keeping this warning in mind, the teacher can get much practical good from them.

set. That gives us, roughly, the *kind* of mind; but as there are larger and lesser apples of every kind, so there are major and minor minds of each temperament. One of mental temperament may be a piping little pedant or a thought-builder of mighty soul.

It is a truism, but one which can not be too often sounded in our ears, that whatever the type of mind, it can not grow to great proportions unless it springs from a healthy nervous system. Seldom do we find a sound mind in an unsound body. The great man is first of all a man of great nervous energy. Health is human horse power.

Mental temperament: levels of ability. — Even in the lower animals, we can see the chief three temperaments illustrated. Among dogs, we have the intelligent shepherd and St. Bernard, the vital-minded pug, and the motive-minded bulldog. In man, we find, in each temperament, levels of ability rising from the animal stage upward.

In the mental temperament, we can readily discover three levels: There are one-story, *perceptive* minds, two-story, *discriminative* minds, and three-story, *constructive* minds. Merely to perceive, and even to remember in a mimic, phonographic way, does not place one at any very proud height above the dog. All begin on the one-story, animal, perceptive level. The crucial question is, How far can a child build above that level? Can he ever learn to discriminate between mine and thine in property; between words and phrases apparently alike, but of different significance; between the good and becoming, and the bad and disgraceful?

Originality, constructive ability ranks highest. Said one of Elihu Root's clients, "I found that while many a

lawyer was able to tell me what I could *not* do, Root was the one man ready to tell me what I *could* do." For one Shakespeare who constructed plays, see how many hair-splitting critics to tear them to pieces! *Thought* which can construct a mental counterpart of the world we live in, and *imagination* which can build new worlds such as we should like to live in, are rare.

Vital and motive temperaments: levels of ability. — Since, in general, exaltation of feeling and excellence of act can only follow some equally lofty sense-complex, we can distinguish in the vital and motive temperaments the same three levels as in the mental. One is (1) perceptive and imitative, or (2) discriminative and critical, or (3) comprehensive and constructive, depending on his level of intelligence.

A good question to ask, especially if we wish to get a moral as well as a psychological rating of any person, is, How large a group is included in his feeling and acting? The petty man can not get beyond himself, or his fraternity, or his class kind, whatever it may be; nor does he regard the rights of posterity. The magnanimous mind responds to the state, the world, and even unborn generations.

Philosophy is the supreme synthesis of knowing, religion the supreme synthesis of feeling, ethics and ethical conduct the supreme synthesis of willing and acting.

Suggestibility and self-determination. — Whether one is a puppet or a person depends on whether he is suggestible or self-determined.

The "natural," animal tendency is to respond to every stimulus immediately by action. This gives to ideas what is known as their "motor aspect": it is impossible

to think strongly of doing any deed without moving at least slightly toward its performance. Some can not approach the edge of a " jumping-off place " without a dangerous impulse to jump. Others are more susceptible to human, social suggestions, and quickly carry out whatever an associate puts into their heads. The trouble with all these people is feeble inhibitiveness. The career of such a one is like the course of a wandering stream, constantly meandering and doubling on itself.

The self-determined person is clear as to his larger purposes, at least, and promptly inhibits whatever would interfere with them. He lives in the master cells of his brain, a brain that has *lodged within itself* the propelling and prohibiting power which the suggestible find outside of them.

A great mind is distinguished by its self-determined loyalty to a long-span purpose.

Dealing with pupils as individuals. — Individuality is based on differences. Luckily, people are not all made after the same machine pattern. Our pupils differ in physique, character, general intelligence; in ideals, special abilities, traits of all kinds. In this chapter, we have noted a few only of the larger contrasts. There are other differences, perhaps less easily observed, but often of importance out of all proportion to the attention they are likely to attract.

Our duty as teachers is not so much to reduce and conceal these differences as to discover and develop them. For their meaning extends beyond the petty performances of school days to the permanent interests of life. Such simple matters as delicacy of touch and steadiness of hand

may determine one's fitness for engraving, dentistry, surgery, or some other vocation.

As in a play, we assign each actor the part in which he fits best, so on the stage of the world, each should find his part according to his talent. When we have learned more minutely the special abilities demanded by each vocation, we shall be able to select more and more accurately the worker who is best fitted for each line of work. In this way the school will be able to remove from the world, in time, the friction and dissatisfaction due to misfit men.

What we must insist on having in our schools, then, are *freedom and stimulus for self-development.* We shall not only tolerate different amounts and rates of work within a class or subject, but encourage an early choice of subjects, with originality and independence in the method of mastering them. Instead of so much mechanical riveting of ready-made facts into the memory, we shall watch our pupil more as he works his way toward graduation, record how his interests bud and grow, and preserve the record so that, when he leaves our school, we shall have a sketch (if not a photograph) of his ambitions, failures, abilities, and achievements, and a clear indication of what he should aspire to next.

CLASS EXERCISE

Select a character well known to the class, perhaps one from history, and let each answer the following questions about him.

1. Long-span or short-span mind? 2. In-minded or out-minded? 3. Temperament: mental, vital, motive, mental-motive, or what? 4. Choleric, sanguine, melancholic, or phlegmatic? 5. Grade of ability: perceptive, discriminative, constructive? 6. To what extent suggestible? Self-determined?

Compare answers and discuss.

The instructor may choose a character known to him only, answer the above six questions concerning the person, and then invite the class to make inferences as to the appearance, habits, occupation, etc., of the unknown one.

FOR FURTHER STUDY

1. Of which temperament do most of the lower animals seem to be? Why is this?

2. How can you tell what to select as a present for a friend?

3. What should you think of a man who, in an ordinary community, insisted that he was surrounded by enemies and must therefore be ready to fight?

4. "Liars should have good memories." What relation has lying to the span of mind?

5. What ails one who frequently resolves to be good, but soon fails?

Explain the psychology of the refrain, "Lest we forget," in Kipling's "Recessional."

6. How comes it that one may believe himself wise, handsome, or good, contrary to fact, whereas a poor man seldom believes himself rich?

7. Should you expect very musical minds to take high rank in mathematics and natural science? Why?

8. It is said that each should have in his skeleton "a jawbone, a wishbone, and a backbone." Show the relation to knowing, feeling, and willing.

9. Which temperament should you choose for an executive position? What has been the temperament of our greatest presidents?

10. Of what temperament have your best teachers been? What should you expect to be the danger of the purely mental temperament in teaching?

11. Which requires the greater ability, to analyze a sentence or to construct one? Why?

12. A certain teacher, on being asked what are the fundamental qualities of the good citizen, replied, "Intelligence, good will, and courage." How do you think he arrived at this conclusion? Which of these did Napoleon lack?

13. Is it not likely that we are all suggestible in some direction, self-determined in others? Discuss this.

14. What is the difference between reasonable self-determination, and merely refusing to take advice?

15. Why has a young child no long-span will?

16. Why do people so often surround themselves with mottoes?

17. Trace the relation of temperament to vocation. Do you find all temperaments in all vocations?

18. Says Emerson, "Prophet and apostle can only be rightly understood by prophet and apostle." Show why.

19. Select and describe some child according to the outline composed in the Exercise at the opening of this chapter.

20. Mention the chief individual differences which you think should be taken account of in teaching.

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CHAPTER XVI

STRIKING VARIATIONS OF PERSONALITY

Exercises. — Give all the reasons you can to show why the many people in the world are not all just alike.

Describe one of the strangest people you have ever known, such as a "fool," or a "crazy" person. Or, describe a piece of peculiar behavior on the part of some one (perhaps yourself) who is usually "all right." (Let some one look up Charles Dickens's description of tipsy conduct, in *David Copperfield*, Chapter XXIV, and report on it.)

Make a list of questions concerning peculiarities of human behavior, which you would like to have answered. Preserve this list until it is called for.

Variations of personality as related to the nervous system. — There are many variations of body, many harmless, some harmful. Perhaps there are even more variations of mind; but these mental differences may lie boxed away in the brain, invisible for years, till some stimulus stirs them out.

Partly for this reason, partly because we believe in the right of each person to live his own life, within liberal limits, our wonder is usually stirred only by the more striking variations of mind and behavior. How explain the hysterical girl, the sleep-walking boy, the hypnotized subject, the chronic weeper or fainter, the "not exactly," the woefully slow and nerveless who can not get excited, the woefully excited who can not slow down but have fits of "nerves" and perhaps get "flighty"?

The real wonder, however, is not that so many have a touch of such trouble, but that any one escapes — if indeed any one does. For these are nerve troubles, and the nervous system is the last and most delicate organ nature has evolved, much more complex and easily injured than the finest watch. The lower animals, partly because of their more crudely built neurones, need no madhouses or homes for feeble-minded. Among them, the lower grades of mind perish by competition. Merciful man protects his mental weaklings, and even permits them to become the parents of more weaklings. Further, his finer intelligence reserves worry as a human privilege: our lower animal relatives do not know enough to worry as we do. This worry-friction throws our mental machines still further out of kilter.

A general view of the difficulty. — Now, what is the matter with our precious nervous systems when they fail to function properly? What ails this chief adaptive system when it does not adapt?

Let us review a little. We have learned (in Chapter I) that mind, our thoughts and feelings, lies between what the world does to us and what we do in return, between stimuli and reactions. There is a constant coursing of currents through some part (though perhaps not always the conscious part) of the nervous system, from stimulus-in to reaction-out. In this chain of nervous events, there are three big links corresponding to the three kinds of neurone (see Chapter V), afferent, connecting, and efferent. The sound mind, then, perceives efficiently, associates (and feels) efficiently, and efficiently goes out into action. The unsound mind (to express the process in the five steps of

Chapter III) fails in gathering experience, or recording and reproducing experience, or analyzing experience, or synthesizing experience, or expressing experience in conduct.

One may be adjudged mentally deranged or malingering when he merely fails to perceive. A soldier was brought to the ear specialist of a camp examining board with the report that he must be malingering, as he failed to respond to commands that were shouted at him, but understood at once when quietly told that dinner was ready. The specialist found that the soldier was stone deaf, but had unconsciously learned lip reading. He could understand only when permitted to watch the speaker's mouth.

Difficulties of perception are illustrated in illusion and hallucination (see Chapter VIII), and in the " clouding of consciousness," which renders it difficult for stimuli to cross the threshold of consciousness and make themselves felt. This may be brought about by disease or other abnormal condition. For example, in delirium tremens, the horrible visions that float through the mind of the patient appear to shut him off from the objective world almost wholly. The people moving about him he does not see, but only those conjured up by his excited brain cells. " Sensory stimuli of ordinary strength or even more than ordinary strength, fail to cross the threshold of his consciousness and cause perception. If, however, the patient be taken firmly by the shoulders and held or even mildly shaken while a question is practically yelled at him, we may find that he will give a perfectly lucid and correct answer. The strength of the sensations has been suf-

ficiently increased, the resistance has been broken down, perception takes place." [1]

Failure to record and reproduce experience normally is found in *amnesia*, or loss of memory. This may be partial, in which case one loses his memory for a certain class of experience, such as words, or for the events of a given period. One such patient, when his wife came before him, could recall when he met the lady, and their associations as friends, but remembered nothing of their marriage or married life. Amnesia may also be general, banishing all memory of one's previous existence. If amnesia is brought on by disease or illness, memory is likely to return; but if it appears as a gradually increasing impairment, as in old age, the outlook is less hopeful.

Examples of faulty analysis and association, feeling, and expression, will appear later in our discussion.

Nervous currents and resistances. — It will help us greatly in understanding peculiarities of personality if we think of an individual as so much nervous energy discharging itself along particular paths. Evidently, then, all depends on two factors, (1) the amount of energy and (2) the paths it follows. Which path is used will depend on the relative amounts of resistance at the various gates of escape. The normal person is charged with a goodly degree of energy, held in perfect control by a system of delicate escapement arrangements.

(1) There may be too little energy to make a person of, so to speak, resulting in some kind of *asthenia*, weakness. Such are psychasthenia (mental weakness) and neurasthenia (nervous weakness, "nerves," "nervousness").

[1] See William A. White's *Outlines of Psychiatry*, p. 51 (6th ed.).

The psychasthenic feels, in general, that the world is too much for him, may have all sorts of fears (phobias) and obsessions, and even comes to feel that such a simple act as getting out of bed and putting on his clothes is for him an enormous impossibility. The neurasthenic finds that even small stimuli and minor matters " get on his nerves " or " drive him wild." If naturally aggressive or in urgent circumstances, he may fidget, scold, and pitch into anything that happens along, sure that the world (and not himself) has gone wrong, and cursing the spite that ever he was born to set it right. If naturally retiring, he is likely to retire still farther and " cry it out."

Further decrease of nervous energy in the upper centers of the brain results in loss of " psychic tension," and so of the " sense of reality," the ability to perceive and feel the world as it is. Things are hazy, obscure, or " mixed up," as when one wakes with difficulty or recovers from some other loss of consciousness. He may even believe himself dead, or that he has become some other person. Perhaps everything seems " far away," as the world appears to recede when we drift off to sleep. There is a lack of pure blood, or of good nerve tissue, or of both these essentials.

Probably emotional exaltation and depression are also closely related to mental (psychic) tension. A good measure of this index of personality can be read off from the tensity, and hence the reflective power, of the eye.

(2) As to channels. If all inhibitors are off, all escapements wide open, we have a nervous condition resulting in convulsions, the convulsive forms of hysteria, and the like. If the channels of the cortex chiefly are free, there

may be mania, or "flight of ideas," expressed, perhaps, in "wild and whirling words." In such condition, unless the nerve currents are moving in torrents, the subject is usually very suggestible, and by a sharp command may even be inhibited into self-control. A physician once found himself alone with a powerful maniac who declared he could jump unharmed from the seventh story window to the ground. He started toward the window, when the physician quickly replied, "That's nothing: I can jump from the ground to the window!" The patient's attention was diverted, and the physician, on being challenged to trial, led him to a place of safety.

Over-inhibition, with closure of channels, probably underlies such difficulties as negativism, melancholia, and the shut-in personality. The negativistic person refuses practically all suggestions, even reasonable requests.

The melancholiac sees all things dark, but does nothing to make them bright. The shut-in personality "closes up" on approach, shares no secrets, and is alone in whatever company. The over-inhibited can often be discovered by watching their limited and somewhat set and mechanical facial movements, especially those of the jaw in speaking.

In dealing with any striking variations of personality, we can usually help ourselves to an understanding of it by considering (1) the source of the stimuli that produce it. For example, diseases such as fevers and pneumonia frequently develop toxins which, by their action on the neurones of the cortex, produce delirium. This is not alarming unless it is an index of a dangerous stage in the

disease. We must consider also (2) the strength of the nervous currents, and (3) their probable course. All queerness is (almost certainly) due to some interference with the proper production or distribution of nervous impulses.

Bodily causes of mental variations. — First, as to inheritance. Mind, *as such*, may not be inherited; but brain is, and the build of the brain has much to do with the make-up of the mind that lives in it. Psychiatrists estimate that from sixty to seventy per cent of all mental troubles have an inherited basis, and there is no case that would not have been different had its inheritance been changed.

We have already (in Chapter II) noted the effect of injury to the brain. In fact, psychiatry and psychology are coming to the conclusion that there is no way to injure the mind unless we do injure the brain. The old principle, "No psychosis without a neurosis," holds throughout. Of course, many of these injuries are not open to the eye, but microscopically small. The physician, by deftly administered doses of certain drugs, can make the patient a devotee of them, powerless to resist. Here is a brain change chemically produced, a new set, minute and subtle, yet tremendous in its effects on the mental life. Many a patient has become a "dope fiend" through ignorance or recklessness in the administering of habit-producing drugs such as morphine, cocain, or heroin, to induce sleep or anesthesia.

Further, the brain may be much upset by disturbances among the bodily organs. The nervous system, as the governing system of the body, is charged with maintaining the other systems in a state of balance, so that each does

its proper work and exercises its rightful influence. But if the body is thrown out of balance, the mind may be unbalanced too. A sluggish liver may cause a sluggish, dizzy mind. A certain type of goiter is accompanied by fear and worry. The mental vagaries due to the sexual system have inspired whole books. In general, physicians expect a patient to be down-hearted if his disease is below the diaphragm, up-hearted and cheerful if it is above — but there are exceptions.

Peculiar mental states due to exhaustion and fatigue poisons, as well as to other poisons, whether introduced from outside the body or formed within it, as in ptomain poisoning, are of common observation.

Mental causes of mental variations. — A man loses his fortune, worries constantly, suffers mental collapse. A father dies suddenly, and his daughter thereafter faints whenever anything causes her to relive the sad scene. A soldier may fear death so much that he commits suicide. A great deal of what passes under the term " shell shock " has no more to do with artillery shells than with oyster shells, but is due to anxiety or other mental strain. A soldier who had come through several battles, sound, began to worry about his sweetheart, and developed " shell shock " on receiving a letter stating that she was untrue to him.

In such cases, the stimuli are too strong for the nervous system that receives them. While the trouble may seem purely mental, there is of course a neural basis for it here also. Some nervous systems, however, are so strong that no mental disturbance can upset them. They can not be driven insane by anything short of chemical action (such as poison) or actual physical injury to the brain.

The subconscious. — We have already glimpsed the subconscious in connection with Common Sense, Subconscious Cerebration, and Brain Set. Brain set, we have found, is unconscious, yet largely determines consciousness. As the " lay of the land " causes water to flow in certain directions, so the set of the brain causes the stream of consciousness to flow in certain channels.

> " I do not like you, Dr. Fell,
> The reason why I cannot tell;
> But this one thing I know full well:
> I do not like you, Dr. Fell! "

Now, the reason why I do not like Dr. Fell may be that some one who looked or acted as he does played me a foul trick years ago — so long ago that I have forgotten both the act and the actor; but the scar is there in my brain, turning the currents of my like and dislike without my knowing why. If I ruminated over it a half hour, I might bring up in consciousness the name and face of the offender, just as by retrospecting my childhood I can bring back many an event lost to me for years, but which did its bit in shaping my character, nevertheless.

Evidently, whatever is " out of mind " may have sunk to different depths, so to speak, from that which is temporarily out of attention (as your name when you are not thinking of it) to that which can be " fished up " with difficulty only, or not at all. Some reserve the term " subconscious " for that which is buried so deeply that we can not bring it back to consciousness at all, such as your performances during the first year of your life. It may include that which never has been conscious (for you), such as the control of the size of the pupil of your eye.

As current events are the most important events for us, but are still only a very small fraction of history, so our present consciousness is most important for us, but is only a very small fraction of our total life. And as the course of current events is fixed by past events, so our conscious lives are like streams flowing over the bed, smooth or rocky, of our subconsciousness.

The subconscious is the (psycho-physiological) stratum of personality which lies between the purely conscious and the purely physiological.

Now, it is characteristic of this subconscious stratum to boil up, so to speak, perhaps even to erupt, into consciousness; and it may intrude its influence in either a wholesome or a harmful way. Just as, in studying memory, we found that one can often recall best by simply waiting until his subconsciousness has found the forgotten item, so authors, artists, and other originators often find they can produce their best results by charging their minds to achievement and then waiting, passively, perhaps, for their "inspiration." Good. But (if we may accept the findings of a very influential school of psychiatrists) there may also be lurking in the caverns of the subconscious many "repressed wishes," perhaps dating back to childhood. The word "wish," as here used, has a very broad meaning. It includes tendencies, leanings, proclivities, appetences, urgings, some of which may never have been consciously recognized at all. Such repressed wishes may set up many sorts of neurasthenic and psychasthenic behavior, and that without the subject's realizing at all the true cause of it.

So, a young lady who often appeared to stumble or leap

in peculiar fashion, explained that she had slipped, turned her ankle, etc. The true explanation was that years before, she had been disappointed in love and had attempted suicide by jumping from a bridge. Without realizing the significance of her behavior, she was partially repeating the original leap in her peculiar jumps.

Evidently, one should be careful as to what he builds into his subconsciousness, or permits to become encysted there. And one of the most serious responsibilities of parents and teachers, probably, is the supervision of the subconscious foundations of personality in children.

Sleep and similar states. — Perhaps the most striking variation of mental personality is its daily vanishing and recurrence. If we were to represent our conscious life by a line, it would be a broken one, as shown, the breaks representing sleep.

The cause of sleep is unknown; but it is commonly accompanied by a reduction of the amount of blood in the brain,[1] by a relaxation of the blood vessels there, and probably by a widening of synapses. Apparently, it is the adaptive systems that most need sleep, for the vegetative systems, though slowed in their activity, continue their work. The cells of the body generally are rebuilt, and in the nervous system, there is a notable replenishing of the nuclei of fatigued neurones.

The threshold of consciousness is higher, rising during the first hour, approximately, and then falling rapidly until the third or fourth hour, after which the average

[1] Some observers state that the quantity of blood in the brain is increased during sleep.

sleeper may be wakened by sounds that are comparatively slight.

The amount of sleep necessary varies much with individuals. Children need more than adults. Certain brilliant persons require only five or six hours of sleep; others, equally able, need nine. If we would be healthy-minded, we must determine the amount of sleep necessary for *us*, and see that we get it. It has been suggested that we may evolve into a race that needs no sleep; but we are not progressing very rapidly in that direction.

Another sleep-habit, invaluable for avoiding insomnia, is that of " switching off " and going to sleep promptly on retiring. Faithful practice when we are free and self-controlled will enable us always to close the curtains of the mind against the glare of care and worry.

Dreams appear to be a kind of mental gambol: our associations, unchecked by the usual restrictions of waking life, run freely wherever the channels happened to be left open when the brain slowed down to sleep. The dream may take its start from a dominant *idea*, as when extremely pleasurable or disagreeable experience with anything is followed by a dream about it; or it may be set up by stimuli *outside* the body, as when a too low temperature starts a dream of icebergs or arctic exploration.

Freud [1] asserts that every dream — and everybody, it is assumed, has dreams, though he may forget them — every dream is the outcome of a repressed " wish." According to the Freudian theory of the subconscious, which underlies this explanation of dreams, our mental life is the result of two motives, usually opposed to each other,

[1] An Austrian psychologist. The name is pronounced as if spelled Froit.

the *pleasure* motive and the *reality* motive. The pleasure motive is our personal desire to express ourselves and to get what we want when we want it, as if the whole world were subject to our will. But "the world," that is external reality, is often cold, resistive, crushing. Hence comes the "reality motive," the necessity of getting what we want, not arbitrarily, but only by adjusting ourselves with the omnipotent environment.

Now, while we are awake, these two motives fight it out as best they may, many wishes being repressed and concealed in the subconscious; but in sleep, the reality motive is removed and the pleasure motive has its free fling. The result (according to this theory) is that our dreams express our deepest natures, and are even more significant than our deliberate statements about ourselves. If you want to know a man, get him to tell you his dreams. According to Freud, the unfulfilled wish which expresses itself in a dream, often takes on a symbolic form: some good person who appears in the dream may represent one's better nature, and so on. A skilled interpreter is necessary to reveal the full meaning of the dream.

Fainting is much like sleep, and may almost be thought of as sleep forcibly induced by shock. No one ever dies of it, and in itself, it is of no great importance. It is serious only when it indicates some serious condition underlying it.

Hypnosis also is much like sleep. Nearly all normal persons can be hypnotized by some monotonous, quieting stimulus which draws and holds the attention, such as gazing upward at a bright object, stroking, pressure on the hands, and the like, especially if reënforced by soothing or overpowering surroundings and "sleep talk," that is,

suggestions of sleep. Waking occurs at the command of the hypnotist, or, if the subject is left to himself, as from normal sleep.

The explanation of hypnosis is yet to be found. The neurones of the subject appear to be given over almost wholly to the control of the operator. There may be "psychic anæsthesia," in which the subject hears, sees, "feels," that only which the operator wishes him to experience, his other sensory neurones failing to function. The association neurones are quiescent, while the efferent fibers carry out the commands of the hypnotist almost as if he had lodged himself in the subject's brain.

One of the most notable after-effects which can be produced by hypnosis is that due to "post-hypnotic suggestion." Although the subject, as a rule, can not recall what took place during his trance period, yet the operator can fix in his subconsciousness a command to be executed later. Such a command is usually carried out faithfully; and the subject, ignorant of the real reason for his behavior, may invent an artificial one.

Because of this strange power of post-hypnotic suggestion, it has been used to some extent to effect cures and personal reforms. A smoker, for example, if told during hypnosis that he will find smoke disagreeable, is quite sure to find it so for a time. But hypnosis as a curative agent is being replaced by milder and more effective means.

Shifting personality. — "I am not myself to-day," I remark, as I realize that I am not feeling or acting quite as usual. Query: then who am I? Further, we all realize that we may be one kind of person at sport, another at study; or that the self-at-home may be quite different

from the self-away-from-home, or the self-alone a contrast with the self-in-a-crowd. The fact is, each of us, instead of being only one, is quite a group: there is enough material in every personality to make a number of persons, if only we could get them parted.

Naturally enough, the way to part them is to make them dislike each other, as the converted man hates his former sinful self. Now, the essential thing in the make-up of a person appears to be *a group of ideas that associate readily*, that are friendly, we may almost say, as a nation is a great group of people in friendly association, organized as a unit. But if there are two centers, we have, in effect, two nations. Something similar is true of the mind. So, a man may live for years as a respected member of some community, but suddenly forget his identity, leave family and friends, go to a new place, take a new name and be a new person, with no memory of his former existence, at all. Later, he may "come to himself" — the old self, and let the new one die. Sometimes there is repeated oscillation between two selves, each of which may or may not be aware of the existence of the other. And these two selves may differ in knowledge, in feelings, and in behavior. They may almost seem to be of different nationalities, for one may know some foreign language and the other not. Indeed, such dual or multiple personalities (for there are sometimes more than two of them) may apparently have nothing in common except that they live in the same body.

The phenomena of the spirit medium seem to be closely related here, since the medium, while in a state of trance, is apparently under the control of some kind of second self. Neither spiritual communication nor communication by

thought alone (telepathy) between two embodied minds appears to have been demonstrated satisfactorily. But we should keep our minds open on such matters.

Hysteria is due to a *shrinking* of the personality, that is, of the field of experience that constitutes the self. Such shrinking apparently results (in part at least) from a lack of sufficient nerve energy to electrify all the neurones that function when the patient is "all there." Because of his patchy, tattered mentality, he may appear to be "beside himself," a different person. Anæsthesia or paralysis of certain parts of the body may also appear, due to the fact that the neurones of those parts are out of commission, or not in proper connection with the high-level centers of the brain.

Insanity. — We have ceased to think of insanity as a sort of demon, an awful thing that gets possession of a person and makes him thereafter a terrible creature. One is insane when he fails to get himself and his environment successfully adjusted; and as we all fail to some extent, we are all insane to some degree.

Using the term *insanity* broadly, it includes *amentia*, lack of mind from birth, as well as *dementia*, deterioration of a mind once good. The three commonly distinguished grades of amentia are exemplified in the *moron* (Greek for *fool*), the *imbecile*, and the *idiot*. The idiot may be able to look after his bodily wants but can do no work intelligently. The imbecile plays, and may be able to do odd jobs and light errands. The moron can do routine work, but lacks the ability to plan. We are learning to recognize the latter two classes in our schools, and to provide courses for them particularly.

Dementia has many forms, the most common being *mania*, *melancholia*, *paranoia*, *general paresis*, and *dementia præcox*. Some of these can be readily understood as exaggerations of original temperament. The flighty, excitable person, of rapid associations, if he becomes unbalanced, is likely to be a maniac; he of slow associations and over-serious views, a *melancholiac*. One of undue self-importance may, by still further exaggeration of his ego, become paranoid, or a paranoiac. General paresis (paralysis) is a gradually increasing paralysis and mental decay, both due to affected brain tissue.

The form of insanity which the teacher is most likely to find in her flock is dementia præcox. The child, who may be of excellent mental ability, is likely to show loss of energy, become moody and " shut-in," grow melancholic and mope alone, and perhaps have delusions and hallucinations, hearing and seeing things which are not " there." He is likely also to think that others are talking about him, ridiculing him, planning and conspiring against him. Such cases should early be brought to the attention of a psychiatrist.

Our attitude toward personal peculiarities. — As stated at the opening of this chapter, we believe in the right of each person to live his life in his own way, within wide limits. We should hold to this attitude. If our fellow man appears queer or crazy, it is probably because we do not yet thoroughly understand him. It will most likely do us good to try to enter into his life, see it from his viewpoint, and think what we would do if we were to live it as our own.

We must be especially tolerant with children; for growth

brings them naturally many vagaries which will just as naturally pass away. We must all develop through many lesser, fragmentary selves toward the unified, complete, whole-souled personality.

CLASS EXERCISES

1. Try to answer now the questions formulated when this chapter was begun.

2. Various members of the class may investigate and report on topics that appear to be of special interest, perhaps spiritism, hypnotism, the education of mentally peculiar children, or the treatment of the insane.

3. Secure from teachers and report on various examples of peculiar children actually found in the schoolroom. Suggest how best to deal with them.

FOR FURTHER STUDY

1. Mention any striking variations of personality you have learned of in connection with historical characters. In connection with well-known literary characters, such as Lady Macbeth. Can you explain these peculiarities?

2. Tell some things you could do to an individual that might cause him to behave queerly. What is the probable action on the nervous system in each case?

3. Children appear to cry more readily than adults. How do you account for this?

4. Mention some facial signs that serve as an index to the condition of the mind, or the nervous system.

5. Suppose a child is controlled chiefly through the motive of fear. What effect is this likely to have on his subconsciousness?

6. Why are individuals, social groups, or nations that have been subject to severe repression, likely to indulge in wild and unrestrained behavior when opportunity offers?

7. What do you think is going on in the nervous system of the sleep-walker?

8. Just how should you determine the amount of sleep necessary for you?

9. A child toys with his pencil and waits for ideas. One who is trying to remember may scratch his head. Explain these cases.

10. Do you think we should make use of the subconscious as much as possible or as little as possible? Why? Mention some of its uses.

11. In case of mental trouble, why is it better to "have it out" than to cork it up in one's heart and brood over it?

12. Psychiatrists say it is often necessary to know the whole life history of one who has mental or nervous trouble in order to understand the case. Why should this be?

13. You find your book or pencil mislaid, can not remember having placed it where you find it, yet know that no one but yourself could have placed it there. Can this be explained in terms of dual personality?

14. Alcohol breaks down inhibitors and puts the higher centers of the brain out of function. Show how this explains some of the behavior of the drunken man. Does temptation then become easier or harder to resist?

15. (*a*) The novice, in driving a machine, often runs it by extremes, perhaps turning the steering wheel too far to right and left, etc.

(*b*) One who is usually strongly inhibited may on occasion "loosen up" and become the most hilarious of a whole group.

Do you see any connection between (*a*) and (*b*)?

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CHAPTER XVII

MENTAL HYGIENE AND MENTAL EFFICIENCY

Exercise. — Consider yourself and your playmates as you were in the schooldays of childhood and early youth. Describe any who were regarded as "queer," who were extremely nervous, or irritable, or possessed of evil habits, or fearful, or passionate, or silly, or impulsive, or whining, always blaming others, or picked upon, or given to worrying, or sulky, or morbid, or very secretive, or inclined to be alone a great deal. Did you show any of these traits? Did your teachers?

How have your companions developed? Have the early peculiarities shown in later life? What, if anything, could have been done for them by a sympathetic teacher who knew them intimately?

Point out conditions which, as you think, made you more or less effective in your mental work.

Briefly describe what you regard as the chief characteristics of a healthy, efficient mind.

The new ideal in education. — "We need more and more a psychology which will occupy itself with character formation and with the individual and its struggles and disharmonies, and, on the part of the school, an appreciation that dry knowledge is not the only thing that is needed, but training to efficiency, and efficiency on the level adapted to the individual, at the bottom of which lies adequate self-management." So speaks August Hoch.[1]

We do not thoroughly educate a child merely by filling his brain full of facts in the hope that the accumulated weight of them will turn the wheels of life to the end. Not *acquisition*, but *development*, is our watchword. Personality

[1] Proceedings of the Mental Hygiene Conference and Exhibit (1912), p. 212.

is like an electric current; and our great achievement for the child lies not in the large amount of work we can get him to do in early years while the current is weak, but in strengthening the batteries until the volts and amperes are so high that ordinary tasks are easy. The education of the future will care less about teaching all branches of study to all pupils, more about saving and using the peculiar powers of the individual mind.

This means an increasing emphasis on mental hygiene and mental efficiency.

Mental and physical health. — Rarely does a rugged mind live in a very frail body. Mind depends on brain, brain depends on blood, and blood must be fed and aired and kept pure.

Most of us know all this, and most of us go on acting as if we knew it not. After a three or four years' campaign against tuberculosis, a physician found a well-to-do family of four living in their own newly-built house, all sleeping in the same room with all windows tightly closed even during mild weather. Two children had died in infancy, and a third was fading. The expert who was called on the case prescribed fresh air. The teacher must serve as priest and minister of Hygeia, and must see, not only that every tongue confesses, but that every knee actually bows,[1] that faith is followed by works.

[1] It is the author's practice to review himself each day on the "Fifteen Rules of Hygiene," as found in *How to Live*, by Irving Fisher and Eugene Lyman Fisk, p. 119. They are as follows:

I. *Air.* — 1. Ventilate every room you occupy. 2. Wear light, loose, and porous clothes. 3. Seek out-of-door occupations and recreations. 4. Sleep out, if you can. 5. Breathe deeply.

II. *Food.* — 6. Avoid overeating and overweight. 7. Eat sparingly of

Rules of mental hygiene. — Health draws; disease repels. And this is true of mind as well as body. The teacher should if possible be a generation better than his time, for after him the next generation will be molded. It would help greatly if we could photograph healthy minds and gaze upon them frequently. But we can study and imitate them. Following are the chief rules which the sound mind seems to obey.

1. *Look at life in the large.* Take a big view of things. As Marcus Aurelius puts it in his *Meditations*, "Look round at the courses of the stars, as if thou wert going along with them." Seeing life as a whole gives a sense of proportion, balance, and harmony. In such a mighty landscape, small things disappear. So we draw the attention of our worried friend away from some troublesome trifle by telling him "It will make no difference a hundred years from now."

Herein lies much of the comfort and joy of religion, philosophy, and science of the grander sort: they show us our petty selves made whole through our relation to the Universe, physical and mental. Recall the oft-quoted words of Kant: "Two things fill the mind with ever-increasing awe and admiration; the star-lit heavens above, and the Moral Law within." Contemplation of such greatness, with the realization that we are a part of it,

meats and eggs. 8. Eat some hard, some bulky, some raw foods. 9. Eat slowly.

III. *Poisons.* — 10. Evacuate thoroughly, regularly, and frequently. 11. Stand, sit, and walk erect. 12. Do not allow poisons and infections to enter the body. 13. Keep the teeth, gums, and tongue clean.

IV. *Activity.* — 14. Work, play, rest, and sleep in moderation. 15. Keep serene.

makes us feel that we are great — and a great soul should do no small thing. The whole-souled man *sees* the unity of the world (knowing), *feels* the actual or possible harmony of the whole, and *wills* and *works* for the welfare of all humanity.

2. *Pursue a great purpose.* Whoever seeks his own selfish will is traveling toward zero; but he who seeks to serve mankind is facing toward infinity. We must ask, as Tennyson does in his *In Memoriam*, that the living will shall "flow through our deeds and make them pure." Our greatest men feel that it is not merely they alone who do their deeds, but some power greater than themselves striving within them, warming them to their work.

Pursuing a great purpose does not mean that we shall all strive for fame, nor that children shall all be spurred to ambitious careers. But the purposeless life leads to despair[1] — and sometimes to tragedy. Mind, like water, should keep moving to keep sweet. As some one has said, "To educate for idleness is to educate for nervousness." The best business for each of us is that which pulls him with the most power.

3. *Practice mental hardening.* When we wish to guard against ills that may attack the body, we harden the body by deliberate discipline, by exercise and cold baths, until it can stand any ordinary shock without damage. Yet our minds, meanwhile, may remain so flabby and tender as to fall a prey to mental disease. Unfortunately, perhaps, we can not bring on the mild mental shock, and steel ourselves to stand it; but we may all spend a little while each day *practicing courage*, setting ourselves to meet with

[1] Read Tennyson's *Sweet My Child, I Live for Thee.*

serenity whatever comes, to fear no evil even though we walk through the valley of the shadow of death.

Children should be encouraged to meet and conquer all their ordinary worries and troubles, and not to shun them. Never to lift a burden means, at length, to have no strength to lift with. The nerve specialist finds it is often the child that has been too much shielded whose nerves give way in later life. While parents should not provoke their children to wrath, they should subject them to annoyance, even artificially created for the purpose, if necessary, and teach them to bear it. But of course such mental-moral exercise should be carefully proportioned to strength, and given always when the child is not fatigued, sleepy, or excited, but fresh and fully fit for an effort at self-mastery.

Those who grow up without graduating from such a course in self-control are likely to fidget themselves and everybody around them who is capable of fidgets. A lady went to her physician begging for help " in the name of mercy and pity." " The sound of her husband chewing at table completely upset her, and when he smoked, the noise made by the puffing of the smoke was torture to her; the creaking of her mother's shoes about the house made her most uncomfortable during a period of several months. Obviously the abnormal idea in such a case caused the suffering, not the sensory impulse itself." [1]

4. *Keep your poise.* Most of us do not sufficiently realize our importance, in a large and sensible way. As Royce of Harvard used to say in his lectures, Each of us is

[1] See *Principles of Mental Hygiene Applied to the Management of Children Predisposed to Nervousness*, by Lewellyn F. Barker, M. D. Published by the National Committee for Mental Hygiene, New York City.

the center of the universe — *his* universe, and round him all is organized; only, we must respect all the other centers of the universe! Feel, and work to make it true, that you have abundance of reserve power. Nothing can destroy you. Be fearless, confident, free from worry, relaxed. Feel, like the athlete, that you are not responsible for the final score; your only business is to play the game well.

"A business man who had set his heart on fulfilling a large responsibility nearly wrecked his health from worry over the outcome. His wise physician prescribed that, before sitting down to his desk each day, he should spend five minutes repeating and impressing on his mind the words, 'I don't give a hang! I don't give a hang!' The truth is many people fail because of over-anxiety lest they fail. Some invalids die from an exaggerated desire not to die."[1]

5. *Form good mental habits.* A person is, pretty largely, his ideals plus his habits. If we get our ideals clear and straight, and form (and break) our mental habits accordingly, we shall be psychically sound.

To go into detail concerning good habits to be formed and bad ones to be broken would in itself require a whole book. Here we can consider, and that but briefly, the general *classes* of mental habit, (1) habits of the intellect, (2) of emotion, and (3) of volition.

(1) Order is not only heaven's first law, but it is the first law of the kingdom of heaven which you hope to set up within you.

Back of all lasting order lies *planning*.

As in the physical world we want a place for everything

[1] Fisher and Fisk, *How to Live*, p. 117.

and everything in its place, so in the mental world we want a time for everything and everything in its time. There should be an ideal for the life, a plan for the year, a program for the day. "The difficulty," says Judd, speaking of overworked teachers, "is not so much in the fact that teachers have to think and plan, as that they come to their work in a state of mental confusion and excitement which renders any task difficult." [1]

Concentration, unit-mindedness, the one-thing-at-a-time attitude, distinguishes the master mind. Work when you work and play when you play. One must concentrate on recreation as well as on work. At table, center your mind on happy eating and agreeable companionship. Don't spoil your game or your walk by carrying all through it a load of anxious thought. And on going to bed, learn to turn off consciousness as you do your electric light.

Says William Penn, "Always remember to bound thy Thoughts to the present Occasion. If it be thy Religious Duty, suffer nothing else to Share in them. And if any Civil or Temporal Affair, observe the same Caution, and thou wilt be a whole Man to every Thing, and do twice the Business in the same Time." [2]

By careful planning, and by concentration in executing our plans, we can avoid one of the most common causes of superficial work and of distress of soul, namely, *hurry*. Observe that the child in school is prevented from planning the larger features of his work, and that school conditions too often favor distraction rather than concentration. It is sad to think how many children are probably contracting bad mental habits in school.

[1] *Genetic Psychology for Teachers*, p. 2. [2] From *More Fruits of Solitude*.

(2) Emotional health requires that we kill off the feelings that are bad for us and practice those that are good for us. There is reason to believe that a large proportion, if not the major portion, of those who lose their positions do not lack either intellect or skill, but emotional control. Many are egocentric, paranoid, have too much self-feeling; others are emotionally unstable; and still others, emotionally weak.[1]

Now, which are the good and which the bad? Feelings are of two kinds, the enlarging and the reducing. We should encourage the enlarging and repress the reducing. By an enlarging feeling is meant one which brings us into relations of unity with a larger circle of environment. Hence the Christian teaching that all-embracing love is the greatest thing in the world, and that even God is love. A reducing feeling, such as clannish or personal pride or hate, tends toward class division and selfish individualism. It would be strange if we were exhorted to dwell in hate, and to believe that God is hate.

One's prevailing mental state should be that of *happiness* and *humor*. It is surprising to find how much can be accomplished by just setting the mind to *be* happy whatever the circumstances. Humor is like an application of mental massage which flushes out fatigue poisons and limbers one up all through. It lets loose the tensity of the mental currents. The mind seems to relax, straighten up from its work, and take a long, fresh breath.

(3) Quiet but effective determination must keep the mental machine running smoothly, rousing us to kill off

[1] See Mental Hygiene, Vol. I, No. 1, *Unemployment and Personality*, by Herman M. Adler.

some thoughts and feelings and promote others. "The curbing of a wish, when this means not only the check but the annihilation of the desire, is a noble exercise of inhibition. The denial of expression simultaneously with the continued entertainment of the wish is exceedingly hurtful. The frequent experience of emotions which do not secure any motor outlet is also abnormal. Anger may not lead to fighting, nor even to scolding, but it may be turned into a motive for vigorous action." [1]

Another large work for the will is that of breaking the *monotony* of the mental life. Changeless experience means mental ruin. There is an old story of a farmer who, mystified at his wife's going insane, said she had nothing to bear, as she had "scarcely stepped outside of her own kitchen for fifteen years!" But monotony is largely a matter of fatigue, which we shall discuss later.

What ails the unhealthy mind? — Health of mind means (1) *self-management* and (2) *adaptation to environment*. If a mind lacks either of these, it is regarded as unhealthy. This is indicated by the more modern term, "maladjustment," that is, bad adjustment, which is now being widely used in place of "insanity." The word *insanity* suggests an incurable terror. *Maladjustment* indicates, and truthfully, a difficulty more or less common to man, and usually temporary.

Two factors must always be considered, the native strength of any nervous system, and the strength of the stimuli brought to bear upon it. The normal nervous system is like a good mousetrap, set to react to stimuli of medium strength. Some traps (and nervous systems) are

[1] Percy Goldthwait Stiles, *The Nervous System and Its Conservation*, p. 171.

too resistive, and refuse to respond even to strong stimuli. But much more commonly nervous systems are too sensitive, and " go off " at the slightest provocation. This gives us the neurasthenic, or " nervous " person.

But the same nervous system may show, now a high, now a low resistance to stimuli. Some of the causes of nervous impairment (listed by Stiles) are poor nutrition, eye strain, bad teeth, nasal obstruction, or other peripheral derangement, bad air, the wrong kind of work, worry, clash of duties, personal antipathies due to lack of tolerance or good fellowship, repressed or unsatisfied desires of a serious nature, double-mindedness or indecision, excessive self-sacrifice. It is important to notice that peripheral derangements such as adenoids, catarrh, or bad teeth, may go on doing damage to the nervous system even after consciousness of pain or discomfort has ceased.

Maladjustment during school days. — No wonder we have so many nervous and troublesome children in school, and so many cases of neurasthenia or more serious maladjustment when school days are over. Psychiatrists tell us that fifty per cent of the insanity in the world is preventable, and that much of it begins in childhood. Of course, we can not expect teachers to turn into psychiatrists and spend their time diagnosing and treating abnormal children, but we can expect them to work for the chief end of education, and that is often stated in the very terms here used, " adjustment with the environment." We must do all in our power, then, to prevent maladjustment both in school and after.

What signs shall we look for so as to recognize poor self-management or bad adaptation? Some of the symptoms,

especially those which may indicate future evil, are seclusiveness, over-secretiveness, lack of frankness, moodiness, inability to get along with others and make friends; excessive day-dreaming, brooding, foolish fancies, and impossible plans; sensitiveness, touchiness, over-quickness at scenting insult or injury, harboring of resentment or unfounded suspicions; self-pity, great depression, self-depreciation; tendency to remain crushed if defeated, excessive indecision, great anxiety, timidity, fear, or worry; sexual vagaries, and peculiar behavior of all sorts.

As you read the list you are likely to feel that you have all the symptoms of future insanity. But, as said before, we are all a little queer — queer enough, let us hope, to make us sympathize with and help those who are seriously so.

What can the teacher do? — The first, and perhaps the greatest thing he can do is to live a life of mental health in the presence of his pupils; *to show them daily a living example of a big, strong, purposeful, well-poised, good-humored, sympathetic soul.* The old adage holds here again: as is the teacher, so is the school.[1] That teacher is mentally weak or ill who hates any pupil, who seeks revenge, or who uses his authority as a means of "getting even" or of inflicting mental torture. If there is to be mental health in the school, some one must begin it.

All treatment, says Hoch, consists in the application of two principles, *rest* and *training*. In other words, we must

[1] "The teacher reports that the boy is very nervous, and the boy thinks the teacher is." From a case reported in Dr. L. Pierce Clark's *Psychopathic Children*, etc., distributed by the National Committee for Mental Hygiene, New York City.

weaken the stimuli, or strengthen the nervous system, or both. The teacher can apply the principle of rest by lightening school tasks, by keeping other children from persecuting the pupil, or even by advising the parents to remove the child from school for a time.

With regard to training, Dr. Abbott's advice applies excellently. We should begin, he says, when these traits first appear, during infancy, perhaps, and never cease our efforts, by every tactful and sympathetic means we can find, " to get into the little mind," to see things as the child sees them, and then, having learned to sympathize with him, to draw him gradually into sympathy with us and our healthful, objective, large-minded way of dealing with the world. To do this successfully, we must remember that children's minds, like flowers, grow and unfold from within: we can not enlarge and form them from without.[1]

Finally, our schools must not force the young to spend fatiguing years in purely academic training and then turn them loose in a world of grime and iron which is anything but academic. The very first aim of the school should be to help each pupil find that position in life where he can serve with greatest efficiency, pleasure, and ease of adjustment.

Fatigue. — If we are to secure mental health and efficiency for ourselves and our pupils, we must understand fatigue and its dangers. Unfortunately for our study, there are so many conflicting statements made about

[1] See *Preventable Forms of Mental Disease and How to Prevent Them*, by E. Stanley Abbott, M. D., distributed by the National Committee for Mental Hygiene, New York city.

fatigue that whoever tries to reconcile them all is likely to know by experience, at least, what it is.

Fatigue is reduced ability resulting from activity. *Weariness* is fatigue-*feeling*, often present when there is no real reduction of ability. Experiment shows that one may feel worse and worse weariness while his work grows better and better. On the other hand, weariness may be wanting when real exhaustion is approaching. There is a story — a true one — of an overwrought woman who, having asked advice of her physician, was told that she must rest. She replied that she was not tired and could not keep still. "Madam," said the physician, "you will have to lie down until you are tired and *then* rest." Probably our fatigue-feelings are much like appetite, a rough and ready guide furnished by nature, to be followed at a distance, but to be carefully studied and regulated by reason.

What happens in the body during fatigue? Energy is consumed, and poisons are formed which prevent our using the energy we have left. If blood from a fatigued dog is injected into a fresh dog, the latter at once becomes fatigued. Poisons formed by the fatigue of any part are carried by the blood to all parts: hence a walk may fatigue the arms, and brain work may fatigue the whole body. While there is such a thing as the special fatigue of a particular part, such fatigue never remains wholly isolated from other parts.

Recovering from fatigue means, not only restoring used cell material, but flushing out the fatigue poisons so we can use the energy we have. If a frog's muscle, dissected out from the body, is fatigued by electrical stimulation, the

fatigue poisons can be washed out by injecting salt water into the blood vessels, after which the muscle will contract again as vigorously as ever. When, during vigorous exercise, we are compelled to breathe rapidly, it is not so much because we need to take oxygen in quickly as because we must throw fatigue poisons out rapidly.

Bodily and mental fatigue. — Muscular exercise not only sends fatigue poisons to the brain, but also, if excessive, withdraws blood from the brain. Mosso found that after pigeons had fatigued themselves by long flight, their brains were very pale and almost bloodless, strikingly different in color from those of pigeons in normal condition. He thinks this explains why pigeons which have flown across from Africa to Italy can not see well when they arrive, and why we fail in our brain work attempted after fatigue.[1] Such withdrawal of blood means a reduction of consciousness.

What is the effect of mental work?

Let us look at a curious fact. Those who die of starvation do not lose brain weight. All organs of the body are reduced, save heart and brain. Up to the very last, the heart gathers from every organ whatever energy the wasting cells of that organ can contribute to the blood stream and carries it to the brain to be consumed. A wonderful economy, truly, for if anything can save the perishing creature, it is a strong heart and a clear brain.[2]

This enables us to understand Thorndike's finding, that under ordinary working conditions there is no such thing as mental fatigue of any practical consequence. There may

[1] A. Mosso, *Fatigue* (Drummond's translation), p. 20.

[2] See Mosso, *op. cit.*, p. 285.

be increased *feelings* of fatigue, but there is little if any decrease in ability even after several hours of hard work. Both teacher and pupils, if they have the will to work, *can* do as much, in any subject, at one time of day as at another. Thorndike found the last half of the afternoon session a little better than the first half. All the facts, he thinks, point to the conclusion that the mental work done in an elementary school day does not at all reduce the ability to do mental work.[1]

Thorndike has stamped his negative on several other current ideas also. He finds there is little or no " initial spurt," or " end spurt," or " spurt after fatigue or disturbance," no proof of rhythm of attention or other rhythm in work, no " warming up " of any moment, no division of mental workers into " early fatiguing " and " late fatiguing," or the like.

Signs of fatigue and weariness. — Many efforts have been made to measure mental fatigue, but all without success, as we should expect: for how can we commonly measure what is not commonly there?

Nevertheless, mental work consumes the bodily substance and produces a certain amount of fatigue poisons. This might enable us to get at the effect of brain work by such means as the ergograph, which is used to measure muscular fatigue. But there are complicating conditions. For example, if emotion accompanies the mental work, it may actually increase muscular power and reaction for a time. (See Ch. XIII.) The effect of fatigue varies much with individuals and circumstances. In general, however, the happy medium of sensitivity to stimuli and

[1] Edward L. Thorndike, *Educational Psychology*, Vol. III, p. 94.

of appropriate reaction which characterizes the normal nervous system, is raised to a too great irritability, or lowered into dullness and indifference. The individual either "goes off" too easily, or is too "dead" to respond at all.

The teacher should practice the recognition of those pupils whose tissues are being consumed by too much work of brain or muscle. As indicated above, *extremes* of condition appear: the figure is either slouchy, with a constant tendency to seek support of some kind, or over tense; the gait drags or shows spasmodic quickness; the face is pale or carries a nervous flush, but is not healthily rosy; there may be much yawning and sleepiness, or insomnia; ideas refuse to come at all or come with such a rush as to confuse utterance; the fatigued person may be precipitate, fiery, and rude in dealing with others, or become too timid to meet them with comfort. Which of these opposite symptoms appear depends largely on the stage of fatigue. Fatigue poison, like alcohol, usually starts an increased liveliness, followed by depression.

The eyelids often droop, the lines of the face turn downward, and the smile is forced or absent. Temperature may be high, and headache or tightening in the head is common, sometimes accompanied by palpitation of the heart, indigestion, and dizziness. Attention wanders from the lesson to the pupil's own condition. He may work feverishly, with many errors, or slow down altogether.

Training for efficiency. — First, what shall we do about fatigue? Avoid it.

Let Mosso teach us again. He found that, by stopping frequently, when a muscle is only half fatigued, it can do

more than double the work it would perform if it worked on until exhausted. Muscles are not like machines which consume the same amount of fuel for each unit of work performed, no matter how long they run. When muscular fatigue has set in, even a moderate amount of work may cause results that are serious. (*Op. cit.*, pp. 151, 152.)

Even if there is no mental fatigue, no actual reduction of ability during ordinary working periods, yet the feeding of bodily energy into the brain during mental work probably (though not certainly) follows the laws of bodily fatigue. In the long run, the student can accomplish most with least expense by taking frequent short rests. Some of our more progressive manufacturers have concluded that they get largest returns from their employees by allowing them ten minutes of every hour for rest. This would probably be a good rule for schools to adopt. And our rests should be devoted, in part at least, to deep breathing. Certainly, growing girls and boys should overrest rather than overwork.

Finally, what is the most efficient attitude for one to maintain toward his work during the working period? Thorndike's phrase, " peaceful absorption," describes it perfectly. Both as teachers and learners, we must practice the habit of putting out of mind everything but one thing, and encourage the feeling of " This-one-thing-I-do." " The little child who complained ' I am tired of not playing,' expressed admirably one feature of fatigue. The strain of not giving way to certain tendencies to respond is as important as the strain of continuing certain others. Work in the popular sense is distinguished from play or recreation less by the amount of positive action than by

the amount of restriction. We are fatigued by what we do *not* do." [1]

What we want in our pupils and ourselves is a deep and quiet flow of energy. *Attention* we must have, but not tension, for that fatigues. And though lightning is spectacular, it really is very weak compared with the great voltage of electricity which modern industry has under quiet control. Nor should we try to start the rushing rapids of emotion, for it wears us much as muscular labor does. The deep water of absorbed interest runs still.

When working in a group, the social spirit should predominate, the feeling of friendliness. That teacher saves herself much fatigue who can throw off all stiffness and over-formality and teach as one who is enjoying a kindly conversation.

CLASS EXERCISES

I

Working either individually, or in a group with the instructor, as he may direct, compile a body of rules designed to keep in a state of mental health any one who obeys them.

Review these rules daily for a week and try to put them into practice. At the end of the week, have reports made to the class as to the value of the plan, with a discussion of helps and hindrances.

Would it be worth while to spend a few minutes meditating on these rules each day?

II

Visit a schoolroom and observe its general atmosphere with regard to mental health and efficiency. Should you like to remain there as a pupil? Why?

[1] Thorndike, *op. cit.*, p. 124.

Do you discover any pettiness or tendency to nag, or is there largeness and cordiality of spirit? Describe the attitude of the teacher toward his class. Does he seem well-poised mentally? Is he evidently under strain, or does he show signs of reserve power which may be tapped if necessary?

Do you think you can discover any very good or very bad mental habits? Any queer pupils?

Do the pupils generally appear fatigued, or in good condition? Give evidences.

Is there " peaceful absorption " in the work? If so, how is it secured? If not, why not?

FOR FURTHER STUDY

1. Select some character which seems to you to be truly great and thoroughly healthy, and describe its most impressive characteristics.

2. What would you do for one who frets much over small matters? For one who spends a long time deciding things of little moment?

3. Tell of some ways or opportunities of practicing mental hardening.

4. If pupils find that they can " rattle " the teacher, or " get on his nerve," what effect is it likely to have on the school?

5. Give examples (actual or possible) of mental suffering or confusion due to bad planning.

6. As you observe life, what happens, at length, to a chronic hater? To one who persistently creates divisions and misunderstandings? To the egotist?

7. Do you see any necessity for making personal, individual rules of mental hygiene, in addition to the general rules? Why?

8. What is likely to be the effect of teasing, on a child who is queer in any way?

9. A large proportion of cases of insanity result from the use of alcohol or from sexual causes. What, if anything, can the school do to remedy this?

10. Why does a horse get nervous with some drivers, but remain quiet for others? Have you noticed any similar situations in schools?

11. Make a list of the traits, or behavior, or physical or mental conditions which you think would necessitate removing a pupil from the common school and giving him special schooling or individual treatment of some kind.

12. What can the school do to " help each pupil find that position in life where he can serve with greatest efficiency, pleasure, and ease of adjustment "?

13. Study your face in the mirror when you are " dead tired." What signs of fatigue do you show? Can you discover any of these signs in other faces?

14. " We are fatigued by what we do *not* do." Apply this to the student who tries to get a lesson while his mind keeps wandering to the party he is missing.

15. Name some of the common causes which prevent students from attaining a state of " peaceful absorption " in their lessons during study hour.

16. To what extent do you think one rests by turning from muscular to mental work or vice versa? By turning from one kind of work to another?

17. Why, do you think, did Lincoln read and tell funny stories at such serious times in his administration?

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INDEX

INDEX

Abstract imagery, 188.
Adaptation, sensory, 125.
Adjustment as test of insanity, 298.
Affection, nature of, 96; and sensation, 97; properties of, 98.
Affective complex, 221.
Amentia, 286.
Amnesia, 274.
Analysis, as aid to progress, 166; in the schoolroom, 162; law of, 163.
Analyzing and associating, 160.
Apperception, 129.
Association, 169; and memory, 152; common course of, 170; law of, 170; speed, range, etc., 175; value of, 173.
Attention, 81; diffused and concentrated, 84; kinds of, 82.
Attitude toward work, 306.

Behavior, 238; and consciousness, 240; high level, 251; instinctive, 243; levels of, 66, 239; value of various types, 250.
Body, brain, and mind, 25.
Brain, changes and growth, 151; description of, 73; how we came to have, 32; like moving-picture factory, 49; work of, 33, 34, 50, 75.
Brain set, 77; as related to recalling, 153.

Centipede, behavior of, 36.
Cold and warmth, 122.
Color, 110; blindness, 115; chroma, 112; complementary, 117; hue, 111; physical and physiological, 113; theory of seeing, 115; value, 112.
Common sense, 214.
Complexes, mental, 99.
Concentration, 296.
Consciousness, and conduct, 72; clouding of, 273; high and low, 84; location of, 64.
Contrast, law of, 126.
Conversational teaching, 307.

Deduction, 211.
Delirium tremens, 273.
Dementia, 286.
Dementia præcox, 287.
Development *versus* acquisition, 291.
Discrimination, and analysis, 161; culture of, 168; demanded for adjustment, 160; practical importance of, 162.
Dreams, 282.

Education of instinct, 246.
Efficiency, mental, 290; training for, 305.
Elements, mental, 99.
Emotion, 231; and instinct, 245.
Experience, gathering, 104–132; recording, 136.

Facilitation, 66.
Fainting, 283.

Fatigue, 301; bodily and mental, 303; from what is not done, 306.
Feeling, 51, 96, 220; and bodily energy, 228; and health, 225; as urge to seek or shun, 230; control of, 232; general course of, 229; good and bad, 297; importance of, 221; influence of, on body, 227; intensity of, 226; kinds of, 231; law of, 223; perfect, 232; related to instinct, 225.
Forgetting, 156.
Freedom for development, 269.
Free images and ideas, 165.
Frequency, law of, 80.
Freudian theory of dreams, 282.

Habit, 246; as universal, 247; constant formation of, 248; of emotional kind, 297; teaching of, 248; of the intellect, 295; of will and action, 297.
Hallucination, 128.
Happiness and humor, 297.
Health, mental and physical, 291.
Hering's theory of vision, 115.
Hygiene, fifteen rules of, 291; mental, 290.
Hypnosis, 283.
Hypnotic suggestion, 284.
Hypothesis, finding the true, 210; variety of, 209.
Hysteria, 286.

Idea, analysis of, 92; motor aspect of, 266.
Ideal, educational, 290.
Idiot, 286.
Illusion, 128.
Image, 93; kinds of, 181.
Imager, types of, 184.
Imagery, and imagining, 179; concrete and symbolic, 187.
Images, value of, 182.
Images and ideas, 208.
Imagination, 189; how to train, 192; in the schoolroom, 194; kinds of, 192; limitations of, 194; practical necessity for, 190.
Imbecile, 286.
Impression, 93; and image, 179; and perception, 126; laws of, 125.
Individual differences, 256; dealing with, 267; in association, 175; in discrimination, 169; in imagery, 186; in thinking, 215.
Individuality, 256.
Induction, 211.
Inhibition, 66; and convulsions, 275; and facilitation, 126.
In-minded and out-minded, 257.
Insanity, 286.
Instinct, 243; and emotion, 245; and habit, 246; and reason, 252; kinds of, 244.
Intensity, law of, 79.
Introspection, 20; practice and value of, 44.

Judgment, 213.

Knowing, feeling, and willing, 261; in the world at large, 262.
Knowledge, kinds of, 210.

Language, control of, 191.
Law, mind subject to, 21.
Levels of the nervous system, 63.

Maladjustment, 298; during school days, 299.
Mania, 287.
Meaning, definition of, 174.
Melancholia, 276, 287.
Memorizing by wholes, 144.
Memory, 137; and brain set, 143; and discrimination, 148; and law of frequency, 149; and law of recency, 150; and mental set, 145; and recognition, 139; and

speed of learning, 148; cultivation of, 142 ff.; definition of, 138; essential processes of, 142; false, 155; loss of, 274; no single center for, 141; result of lack of, 137; subjective mark of, 139; systems, 144; through intensity, 147.
Mental ailments, 298.
Mental and environmental, 41, 42.
Mental hardening, 293.
Mental hygiene, rules, 292.
Mental peculiarity, 271; and the subconscious, 279; bodily causes of, 277; in children, 300; mental causes of, 278; tolerance toward, 287.
Mental set, 78; in recalling, 154.
Mental temperament, 263.
Mind, analysis of, 91; and brain, 37, 38; as a whole, 257; body, and environment, 46; inclusiveness of, 266; its chief processes, 50; made of what, 91; nervous system, and behavior, 54; outline of, 239; short-span and long-span, 259; types of, 265; the unhealthy, 272; what it is, 45; what kind and how much, 264.
Mood, 231.
Moron, 286.
Motive temperament, 264.
Music, psychology of, 108.

Nature and human nature, 41.
Negativism, 276.
Nerve currents, 58, 59.
Nervous channels and mental currents, 72.
Nervous system, and education, 68; as governing, 28; cut of, 29; how it controls, 35; lacking, 30; levels of, 63; primitive, 30.
Neurasthenia, 274.
Neuro-muscular connections, 56.
Neurones, 57; kinds, 59.
Objective and subjective, 43.
Observation and inference, 210.
Organic impressions, 124, 222.

Pain, 123.
Paranoia, 287.
Paresis, 287.
Paths, laws of forming nervous, 77; possible nervous, 62; preferred, 61, 76.
Perception, 50, 92; analysis of, 92; classes of, 127; difficulties, 273; false, 128; of space, 131; as related to idea, 93, 95.
Perceptive types, 127.
Personality, and inheritance, 277; and nervous energy, 274; as related to nervous system, 271; organization of, 285; shifting, 284; variations of, 271.
Phrenology, 263.
Physiological systems, 26.
Pleasure motive, 282.
Poise, mental, 294.
Primacy, law of, 81.
Psychasthenia, 275.
Psychic tension, 275.
Psychology, among other branches, 13; and logic, 204; as science of subjective, 43; branches of, 18; method in, 19; purpose of, 16; subject matter of, 17.
Psychopathic children, 300.
Purpose, 259; and mental health, 293.

Reality motive, 282.
Reason and instinct, 252.
Reasoning, 213.
Recalling efficiently, 152.
Recency, law of, 80.
Recognizing efficiently, 155.
Repressed wishes, 280.
Retaining efficiently, 150.
Rhythm, 130.
Romance and reflection, 229.

Science, nature of, 15; purpose of, 16.
Self as key to other selves, 257.
Self-determination, 266.
Self-management, 298.
Sensation, 95, 261; and affection, 97, 222; properties of, 98.
Sense-feelings, 222.
Senses, order of appearance of, 104.
Sentiment, 232.
Shifting personality, 284.
Shut-in personality, 276.
Signs of fatigue, 304.
Sleep, 281.
Smell, 121.
Sound, physical and physiological, 105; quality and intensity of, 107; three kinds of, 48.
Space, perception of, 131.
Spirit medium, 285.
Stimulus, 17, 55; resistance to, 298; too strong, 278.
Subconscious, as basis of personality, 279; cerebration, 176.
Sub-habit, 242.
Suggestibility, 266.
Sympathy as key to child mind, 301.
Synapses, 60.
Synthesis, mental, 100.
Systems, of the body, 26; maintenance and adaptive, 27.

Tactual-motor sense, 123.
Taste, 120.
Teacher as mental model, 300.
Teaching of habit, 248.
Telepathy, 286.
Temperament, 262; and levels of ability, 265.
Thinking, 198; as discovery of relations, 213; essentials of, 208; how it goes on, 201; naïve and reflective, 202; training children in, 215; value of, 200; why so imperfect, 204.
Tones, charted, 108.
Touch, 122.
Training for efficiency, 305.

Unity of mind, 173.

Versatile and non-versatile minds, 184.
Vital temperament, 263.

Weariness and fatigue, 302.